

**Independent Management Audit of
Duke Power Company's Restoration and
Maintenance Practices**

November 2003

For the South Carolina Public Service Commission in
Response to Solicitation 03-S5814

Barrington-Wellesley Group, Inc.

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CHAPTER I

Introduction

This chapter is organized as follows:

- A. Background
- B. Approach
- C. Auditing Standards

A. BACKGROUND

Nearly 2 million electric customers lost power during an ice storm that hit the Carolinas on December 4 and 5, 2002. Almost 1.4 million of those without power were Duke customers. On December 8, 800,000 customers were still without power, despite the efforts of nearly 7500 utility workers from out-of-state, who joined in the repair effort. Duke said at the time that it expected to have 90 percent of the outages restored by December 11. In the end, it took nine days to restore power to all customers.

Duke ultimately spent \$100 million on restoration and clean-up from the December storm. These costs included 3200 new power poles, 549 miles of wire and 2300 transformers. Duke brought in crews from 17 states to help restore power to its customers.

At the request of State Senator David L. Thomas of Greenville, Duke officials met with upstate South Carolina legislators and emergency management officials on December 18, 2002, some of whom were highly critical of Duke. At that meeting, Duke agreed to make a few changes in the way the company handles storm-related power outages and review its tree-trimming practices. Duke officials insisted, however, that it already has an aggressive tree-trimming program and stated that putting overhead lines underground is prohibitively expensive, about \$350,000 per mile. Senator Thomas subsequently requested that the South Carolina Public Service Commission (SC PSC or Commission) order an independent management audit of various issues involving Duke's performance during the December ice storm.

The Barrington-Wellesley Group (BWG) submitted a proposal and was eventually selected by the Commission to conduct this independent management audit of Duke Power Company's (Duke or the Company) service restoration procedures for its South Carolina retail electric service area in a carefully planned, thorough, well-documented and cost-effective manner. This chapter of the report from that investigation describes the activities and approach we utilized to accomplish the audit.

B. APPROACH

BWG conducted the audit in four steps as described below:

Step One: Orientation And Planning

The objectives of this first step of the investigation were to (1) review specific SC PSC objectives for this management audit, (2) develop a clear understanding of the events surrounding the December 2002 ice storm that resulted in power outages to Duke's customers, (3) become familiar with Duke's organization, particularly those departments and groups responsible for communications, customer service, maintenance and construction, human resource planning and emergency preparedness and (4) gain an understanding of Duke's requirements for providing service and communicating with its customers, the media, regulatory bodies and other government agencies. Based on the information we collected in this step, we developed working hypotheses for each of the major issue areas to be evaluated and finalized a detailed work plan to guide our efforts during the remainder of the investigation. The orientation and planning step was completed during the first two weeks and involved three activities:

- Initial interviews and presentations
- Preliminary data gathering and analysis
- Project planning.

Step Two: Detailed Analysis and Verification

This step involved the principal investigation and data collection that was performed during the audit. Its purpose was to gather data needed to examine and assess the issues described in the Work Tasks in the Commission's Request for Proposal (RFP). The project team integrated and summarized information gained during this step and developed preliminary findings, conclusions and recommendations. Work Tasks included the following:

- Reviewed and analyzed power restoration procedures, specifically those pertaining to Duke's South Carolina electric retail service territory. BWG's analysis included a review of Duke's service related operations manuals, system restoration plans, emergency procedures and service regulations.
- Reviewed and analyzed Duke's public information and other communications procedures associated with providing timely and accurate data and information concerning power restoration timetables and activities to its South Carolina electric retail customers, other agencies and organizations responsible for public health and safety as well as emergency preparedness entities.
- Reviewed and analyzed Duke's activities and performance leading up to and including the restoration of retail electric service in South Carolina associated

with power disruptions and outages resulting from the winter storm that commenced on or about December 4, 2002 .

- Performed a critique of the effectiveness of Duke's actions and activities related to the December 2002 storm. This critique encompassed:
 - Breakdowns in Duke's communications with emergency preparedness agencies.
 - The inability of Duke to provide timely and accurate information to its South Carolina electric retail customers related to estimated restoration times.
- Performed an exhaustive review and critique, associated with the December 2002 storm, of Duke's preventive maintenance programs, incorporating in this analysis the possible impact recent personnel cutbacks may have had in contributing to the level of effectiveness.
- Reviewed the possible mitigation of adverse impacts from implementation of an aggressive pole and cable restoration program in conjunction with accelerated tree trimming activities.

Step Three: Report Preparation

We prepared and submitted to the SC PSC staff a draft report covering each focus area of the investigation. The draft report described each focus area, our evaluative criteria, findings and conclusions, and our recommendations for improvement. The draft report provided a complete description of the results of our review of the respective task areas. In preparing the final report, the only changes BWG made to the draft report were in response to specific comments from the SC PSC staff.

BWG's final report provides a detailed analysis for each of the Work Tasks set forth in the Commission's RFP. The report includes an executive summary to provide a comprehensive and concise rendering of BWG's analysis, results, conclusions and recommendations. The report contains a complete record of our analysis and work activities in accomplishing the requirements of the Commission's RFP. BWG's results, conclusions and recommendations were specifically identified and enumerated as well as supported by evidence, facts, data and sound logic.

Step Four: Presentations

BWG's project manager is prepared to make a presentation to the Commission of our report explaining our analyses, critiques, findings, conclusions and recommendations on a mutually agreeable date in Columbia, South Carolina. The project manager will be accompanied and assisted by other team members as necessary to adequately convey the results of the audit. BWG will provide additional presentations to the Commission as required.

C. AUDITING STANDARDS

The three parties involved in BWG's quality assurance process for this audit were BWG consultants, the BWG Project Manager and the SC PSC Project Manager. Our approaches to project management and preparing an audit trail are essential components of BWG's quality assurance process. The BWG quality review process is designed to assure adherence to Generally Accepted Auditing Standards in accordance with "Government Auditing Standards" (1994 Revision) issued by the Comptroller General of the United States. No information was omitted from this report because it was deemed privileged or confidential.

The BWG Project Manager was responsible for day-to-day monitoring of work, reviewing work products for compliance with project goals and objectives, and for anticipating and responding to problems or concerns. He ensured that the consultants were adequately supported, enforced administrative controls, assured consistency among approaches and methods, and scheduled work to ensure that the consultants were efficient in their efforts. He periodically reviewed the work in progress by attending interviews, assessing the processes used in analysis, testing conclusions, and checking the clarity and completeness of all written materials.

The SC PSC Project Manager reviewed the process and analysis used by the consultants, and he reviewed the work products prepared by the review team. This review proved useful in ensuring the audit team placed appropriate emphasis on issues important to the SC PSC.

BWG's review process ensures that work is factually based, that the observations and comments formed are supported by relevant data, that professional judgment, where applied, is differentiated from analytical results, and the results of the review are easily traceable to specific consultant efforts. Prior to issuance of this report, Duke Power was provided the opportunity to review the facts in this report to ensure their accuracy. Based on the comments received, and the approval of the SC PSC Project Manager, BWG made revisions to the report as appropriate.

CHAPTER II

Executive Summary

This chapter is organized as follows:

- A. Findings and Conclusions
- B. Summary of Recommendations

A. FINDINGS AND CONCLUSIONS

Duke Power made an excellent tactical response to the December 2002 ice storm. Consistent with the best practices of electric utilities, a fulltime emergency preparedness manager led Duke's response to the December 2002 ice storm. In response to advance weather warnings, Duke prepared several days ahead of the storm by alerting key personnel, holding emergency response team conference calls, contacting the Southeastern Electric Exchange (SEE) for outside assistance, and staging crews in field locations. Safety was emphasized throughout the nine-day restoration. Personnel and public safety was effective, even in face of the fact that thousands of linemen and right of way workers were engaged in the restoration. Duke uses an appropriate restoration priority sequence that is common among electric utilities within the industry.

During the December 2002 ice storm, Duke used its Emergency Service Restoration (ESR) system to record and report outage information. The ESR system performed throughout the storm without experiencing a computer system outage and operated at an average of over 1,000 ESR transactions per minute during the peak hours of December 5-10, 2003. While the ESR system handled the volume of calls received, it was not designed to generate automated estimated times of restoration (ETORs) for an event of the December 2002 ice storm's magnitude. The ESR system performs adequately on more normal day-to-day outages (typically lasting six to eight hours or less). Consequently, the outage management system that was in existence at the time of the December 2002 ice storm was inadequate, as were the processes for resource assessment and for developing and disseminating accurate estimates of service restoration times to the customers. At the storm's peak, about 306,300 South Carolina customers were without power. By the time that community-specific ETORs were provided in a press release at 10:00 PM on Saturday, December 7, 2002, only about 82,000 or 25 per cent of the South Carolina customers were still without power.

Duke may have understated the expected impact of the storm in its initial internal communications. Such information is essential to estimate the projected number of outage calls that will be made, determine how many customer service representatives will be needed to respond to those calls, and provide an early assessment of the volume of resources that will be needed to repair the system. As a result, some organizations were less than optimally prepared during the early days of the storm. Customer service personnel recognized that they had more outages than the forecasted "250,000 outages" as early as the morning of December 5, 2002.

Most government agencies and emergency preparedness entities were satisfied with the communications from Duke during the storm. Representatives from the State, counties and cities reported that Duke communicated with them to their satisfaction and provided adequate contact

through established relationships with the Company's District Managers. The South Carolina Emergency Management Division office indicated that Duke was responsive in providing numbers of customers out of power, was open to their suggestions about restoration priorities, and provided timely information that was needed by the collective agencies in managing emergency situations. However, two of the three largest South Carolina cities that had extensive damage during the December 2002 ice storm experienced some difficulty contacting Duke during the first twenty-four hours of the storm.

Within weeks following the storm, in December 2002, Duke effectively took the initiative to solicit feedback for improving its emergency plans with the Company, city, and county organizations and promptly began initiating some of the recommended changes. Duke also initiated a December 2002 Ice Storm Critique, which identified over 852 items that were divided into four categories: quick fixes, short-term actions, long-term actions, and no action necessary. While Duke took the initiative to develop lessons learned, the Company may not have adequately followed through. Despite damage to 3,200 distribution poles, Duke did not perform a formal failure analysis that would be expected from an event of this magnitude and did not attempt to determine what preventive steps could be taken to avoid extensive damage in the future. Further, since so many of the outage causes were attributed to trees, it is not unreasonable to expect that Duke would attempt to determine what preventive steps could be taken to avoid such extensive tree damage in a future ice storm. BWG did not find an action item related to vegetation management in the lessons learned project charters.

Some aspects of Duke's organizational and management practices such as compensation programs, budgeting, and manpower planning may have contributed to Duke's performance issues during the December 2002 storm. After undergoing a series of organizational changes during the 1990s and 2000s, Duke recently returned to an area-based organization that emphasizes the sense of ownership and accountability for the distribution system. The most recent reorganization occurred in August 2003, which resulted in combining distribution and transmission, continuing the leveraging process for operational efficiencies and consistency, and increasing the level of operational responsibility for the regions while continuing to ensure consistency and sharing of best practices. BWG determined that Duke has an appropriate level of technical training provided to maintain the technical and safety skills needed by their electrical workers in operating and maintaining the distribution system.

During Duke's re-organizations, the Company initiated several workforce reduction programs all of which amounted to a very small percentage of the total workforce at the time. It is not likely that any of these downsizing efforts significantly impacted the effectiveness of the operating and maintenance workforce. However, staffing levels for Duke's electric distribution organization are not adequately based upon quantified data. There is no indication that the decisions to proceed with any of these downsizing efforts were supported by a quantified analysis of workload versus the work force that was expected to be retained in order to ensure that the remaining work force would be sufficient.

Employee incentive compensation programs for Duke's electric distribution personnel favor earnings over reliability. From 1999 through 2003 employee incentive compensation measures were predominantly based on economic considerations, such as earnings per share (EPS) and earnings before interest and taxes (EBIT). These measures accounted for fifty percent of total incentive compensation from 1999 through 2002 and seventy percent in 2003.

Since the early 1990's, Duke exercised cost control and reduction policies that may have resulted in less than adequate funding of its South Carolina electric distribution system. Duke's O&M and capital budgets remained relatively flat during 1999-2002. However, when expressed as a percentage of Duke's total O&M and capital expenditures, the South Carolina portions actually declined. It is not clear why expenditures in South Carolina fell behind those for the rest of Duke's system. Throughout the period, Duke had adequate budgeting tools and procedures in place. The level of funding for the electric distribution system was the result of a conscious and concerted effort. Budget call letters and other guidance in two of the years were clear and specific with regard to requiring a reduction in expenditures and maintaining costs at the lowest possible level in order to promote growth in earnings before interest and taxes.

The reliability of Duke's electric distribution system declined in 2002 following several years of improvement. Duke's electric system reliability, as measured by three indexes that are commonly used throughout the electric utility industry, showed mostly favorable trends from 1998 through 2001, then all declined in 2002. None of these indexes were affected by the December 2002 ice storm since all major outages are excluded from the data.

Duke Power's electric distribution design and construction standards are well written and complete. Moreover, Duke's electric distribution system appears to have been constructed in accordance with the Company's standards and specifications. Duke Power's pole reinforcement program is a good practice. Distribution poles that are identified through Duke's pole inspection program as needing maintenance rather than replacement are reinforced with steel. This program enhances safety and reliability and also probably generates a cost savings. Duke Power also has an effective cable replacement program that has taken an aggressive approach to replacing aging cable.

Nonetheless, Duke Power's design and construction standards may have prevented the distribution system from being optimally prepared for the December 2002 ice storm. Duke Power's distribution system has been designed in accordance with the National Electrical Safety Code (NESC) for medium ice loading criteria. According to the NESC, most of South Carolina is classified as a "Medium Loading" area, wherein the NESC recommends consideration of one-quarter of an inch of ice in the utility's design criteria. Use of the NESC ice loading criteria is a good practice and meets standard utility practice. However, Duke's South Carolina system is unusual in that parts of its service territory have a history of major ice storms, which may not be adequately addressed by the NESC.

Duke Power is not adequately applying modern technology monitoring and controlling its distribution substations. Duke does not have a Supervisory Control and Data Acquisition (SCADA) system for its distribution substations; nor does the Company appear to have any plans for future implementation of a SCADA system. This is quite unusual for an electric utility of Duke Power's size and stature. Proper use of a SCADA system would provide valuable information for prompt analysis of system problems and would aid in the restoration of service during situations such as the December 2002 ice storm.

Duke Power has not adhered to its ten-year pole inspection program that is specified by Company Distribution Standards. Duke stated that the Company changed the line inspection program in 1998 to a twelve-year program and that the Distribution Standards will be revised. However, it appears that even the 12-year goal was not met in South Carolina until 2002.

Although the percentage has gradually increased, it did not reach the earlier design objective of ten percent in any year.

BWG determined that Duke Power has an extensive overhead distribution system that cannot economically be converted to underground. Assuming that the average conversion cost is \$500,000 per mile, the cost of conversion for the approximately 17,500 miles of overhead lines in South Carolina to underground would be \$8.75 billion. These numbers are based on the low-end costs for conversion of simple lateral circuits. The total cost for the conversion of the entire South Carolina distribution system to underground could easily be twice that amount or more. With about 500,000 customers in South Carolina, the average investment per customer would be approximately \$17,500 on the low end and possibly more than \$35,000 on the high end.

Duke's current vegetation management practice could contribute to future reliability problems. BWG's investigation revealed that trees accounted for about a third of outage durations for the Company's South Carolina customers during the years 1999 through 2002. BWG also found that during the last 10 years the average duration of a tree related outage was approximately 183 minutes.

BWG found several deficiencies in the Company's program. The length of Duke Power's tree trimming cycle is longer than many utilities in the industry and does not meet standard utility practices. A number of studies have been performed that demonstrate that the optimal tree trimming cycle is four years, with some mid cycle trimming still being beneficial. Duke does not keep track of the types of problematic trees in its service area, does not track the annual growth of problematic trees, and does not have an idea of the numbers of trees along its lines and rights-of-way. Vegetation management appropriations for South Carolina have not kept pace with those of the Duke Power system overall. Inspection of several distribution lines in the Spartanburg and Greenville areas revealed potential problems and conflicts with trees, which suggests that the distribution system is still quite vulnerable to tree related outages despite Duke's current vegetation management program.

Duke's customer service organization has a comprehensive emergency plan that provides operating guidelines, staffing needs and high-level team responsibilities for responding to emergencies. The customer service organization is structured appropriately and roles and responsibilities are clearly defined. Customer service performance measures are appropriate and typical of other utilities in the industry.

Nevertheless, Duke's customer service organization was not adequately prepared for the December ice storm. Customer service did not ramp up personnel in response to the advance weather warning and severely underestimated the impact of the weather on customer outages. While Duke's customer service technology infrastructure is generally appropriate, some of the new systems' capabilities are not fully understood, tested and utilized. While Duke has an excellent training program for new hires into the customer service organization, Duke did not provide adequate training for auxiliary agents who handled escalated calls during the ice storm. Additionally, Duke may have reduced staffing to the detriment of service levels.

B. SUMMARY OF RECOMMENDATIONS

This report contains a total of twenty recommendations. Detailed findings and conclusions supporting the recommendations are provided in the related chapters. BWG has assigned a priority ranking of “A, B or C” to each recommendation, with “A” being the highest priority. **Exhibit II-1** provides the findings and the recommendations and a priority ranking for each recommendation. It also provides the primary benefit as well as the level of effort required to implement each recommendation. The primary benefit classifications include: improved storm response,” “protect ratepayer interests,” “improved service reliability,” “improved customer service” and “enhanced safety and security.” BWG has classified the level of effort required for each recommendation as either “nominal,” “moderate” or “significant.”

C. EXHIBIT II-1

Summary of Recommendations

Chapter	Rec. No.	Finding/Recommendation	Priority	Benefits	Level of Effort
III		The outage management system that was in existence at the time of the December 2002 ice storm was inadequate, as were the processes for resource assessment and for developing and disseminating accurate estimates of service restoration times to the customers.			
III	1	Improve the systems and processes used to develop and communicate ETORs to the customers during storms and take advantage of tools and technology available to automate resource management. Duke should continue efforts already underway to correct these deficiencies.	A	Improved storm response and customer service	Significant
III		Duke may have understated the expected impact of the storm in its initial internal communications.			
III	2	When preparing for weather related events, enhance the method used to forecast the volume of outages and the resources needed for restoration. For example, in addition to designating an event as “affecting greater than 250,000 customers” and labeling it a category IV storm, prepare a detailed estimate of the number of outages expected as well as the corresponding resources required for restoration.	A	Improved storm response and customer service	Moderate
III		Duke did not have pre-determined estimates of the number of scouts needed by zone.			

Chapter	Rec. No.	Finding/Recommendation	Priority	Benefits	Level of Effort
III	3	Develop a process for identifying and assigning scouts and field team leaders to specific areas and pre-stage these resources ahead of major events. Determine the number of scouts necessary to perform damage assessments by map grid or circuit for each zone for large-scale restorations.	B	Improved storm response and customer service	Nominal
III		Adequate lines of communication between Duke and emergency services agencies were not established early enough to effectively manage the initial stages of the storm.			
III	4	Continue to proactively reach out to counties and major municipalities to inform and educate customers regarding the Company's emergency plans and what to expect during major storms.	A	Improved storm response and customer service	Nominal
III		While Duke took the initiative to develop lessons learned, the Company may not have adequately followed through.			
III	5	Modify lessons learned procedures and document retention policies in order to provide for more thorough investigations of storms and other emergency events and ensure the implementation of corrective actions identified.	B	Improved storm response and customer service	Moderate
IV		Duke has made a number of changes in the organizational structure of its electric distribution organization regarding system ownership, responsibilities and objectives during the late 1990's and early 2000's.			
IV	1	Maintain the area-based organization that currently exists.	A	Improved service reliability and customer service	Nominal
IV		Employee incentive compensation programs for Duke's electric distribution personnel favor earnings over reliability.			

Chapter	Rec. No.	Finding/Recommendation	Priority	Benefits	Level of Effort
IV	2	Revise employee incentive compensation measures in order to increase emphasis on system reliability.	A	Improved system reliability Protect ratepayer interests	Moderate
IV		Staffing levels for Duke's electric distribution organization are not adequately based upon quantified data.			
IV	3	Develop and implement a comprehensive manpower-planning program.	B	Protect ratepayer interests	Moderate
IV		Since the early 1990's, Duke exercised cost control and reduction policies that may have resulted in less than adequate funding of its South Carolina electric distribution system.			
IV	4	Reevaluate the South Carolina electric distribution system capital and O&M budgets and avoid any future cost control efforts until system reliability indices improve.	A	Improved service reliability	Significant
		The reliability of Duke's electric distribution system declined in 2002 following several years of improvement.			
IV	5	Determine the root causes of the recent decline in electric system reliability.	A	Improved service reliability	Significant
V		Duke Power's design and construction standards may have prevented the distribution system from being optimally prepared for the December 2002 ice storm.			
V	1	Use a combination of the NESC heavy ice loading and ASCE standards as criteria for the design and construction of the electric distribution system.		Improved service reliability	Significant
V		Duke Power is not adequately applying modern technology monitoring and controlling its distribution substations.			

Chapter	Rec. No.	Finding/Recommendation	Priority	Benefits	Level of Effort
V	2	Develop and install a SCADA system to include all major distribution substations.	A	Improved storm response Improved service reliability	Significant
V		Duke Power has not adhered to its ten-year pole inspection program.			
V	3	Increase the frequency of distribution pole inspections.	B	Improved service reliability	Moderate
V		Duke's current vegetation management practice could contribute to future reliability problems.			
V	4	Reduce the cycle time of the tree trimming program to four years.	A	Improved storm response Improved service reliability	Moderate
V		During the technical investigation of this audit, BWG made a number of observations regarding the operation and maintenance of Duke's distribution system that indicated additional areas for improvement.			
V	5	Duke Power should conduct an internal audit of the security fences of all of its substations and bring the security fences for each substation into compliance with the NESC.	A	Enhanced safety and security	Nominal
V		During the technical investigation of this audit, BWG made a number of observations regarding the operation and maintenance of Duke's distribution system that indicated additional areas for improvement.			
V	6	Duke Power should develop a plan for implementing an under frequency load shedding program.	B	Improved storm response Improved service reliability	Moderate
VI		Duke's customer service organization was not adequately prepared for the December 2002 ice storm.			
VI	1	Modify emergency planning procedures in order to implement a more effective means of estimating resource requirements.	A	Improved storm response and customer service	Moderate

Chapter	Rec. No.	Finding/Recommendation	Priority	Benefits	Level of Effort
V1		While Duke's customer service technology infrastructure is generally appropriate, some of the new systems' capabilities are not fully understood, tested and utilized.			
V1	2	Conduct a comprehensive assessment of customer service business processes and technology infrastructure in order to identify opportunities to improve service levels while continuing to control costs.	A	Improved customer service Protect ratepayer interests	Significant
V1		Duke did not provide adequate and consistent training to its auxiliary agents who handled escalated calls during the December 2002 ice storm.			
V1	3	Provide regular training to Duke's non-customer service employees who may be required to serve as auxiliary agents during an emergency.	B	Improved storm response	Nominal
V1		Duke may have reduced staffing to the detriment of service levels.			
V1	4	Determine the optimum staffing required in the customer call center in order to achieve an appropriate level of service to Duke's customers.	B	Improved customer service	Moderate

CHAPTER III

December 2002 Ice Storm

This chapter provides an overview of Duke Power's (Duke or the Company) response to the December 2002 ice storm. The assessment was based on a review of events beginning with identification of the threat to the electric distribution system posed by the storm and ending with the Company's efforts following the storm in developing lessons learned and plans for responding to future incidents. The review included examination of the organizational relationships within and among the departments responsible for responding to the storm, the processes and practices employed and the measures used to evaluate the Company's performance in restoring power and communicating with customers, government officials and emergency agencies regarding power restoration schedules and activities.

A. BACKGROUND

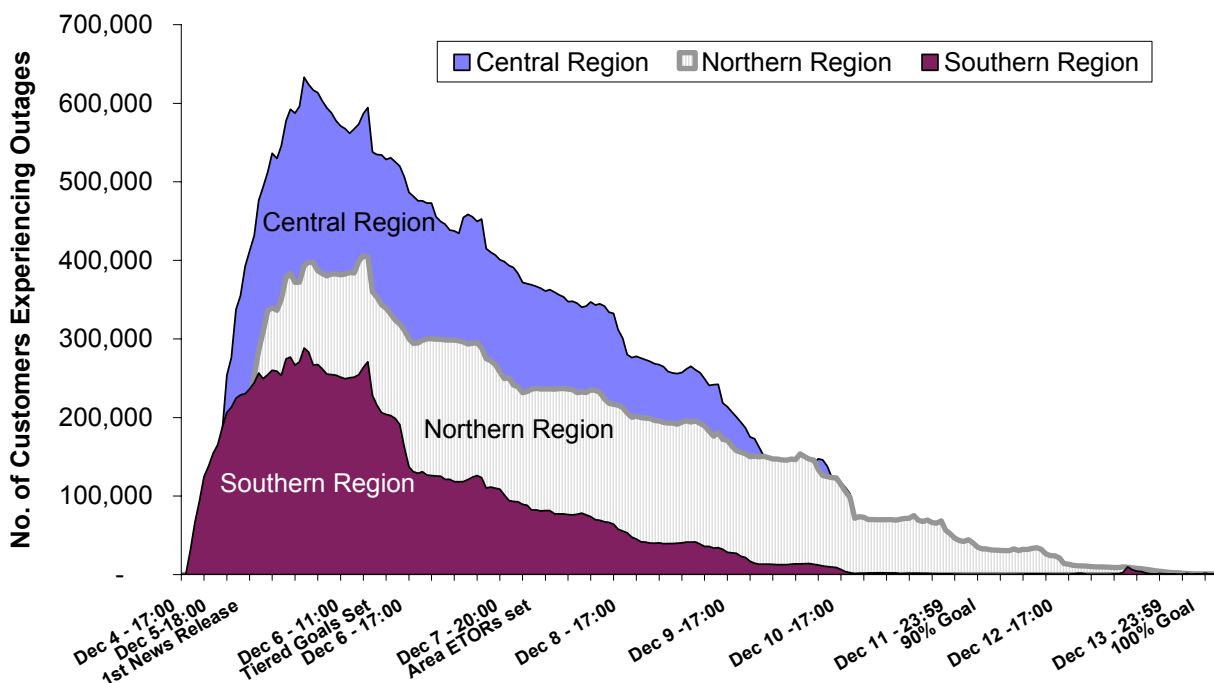
The National Climatic Data Center (NCDC) Storm Event Database reported the following description of the December 2002 ice storm in South Carolina:

4 December 2002, 3 PM to 5 December 2002, 7 AM - *Freezing rain began across upstate South Carolina during the early afternoon of the 4th, and had spread into the eastern piedmont by mid-afternoon. Resultant damage due to ice accumulation began during the mid to late afternoon. The intensity of the freezing rain increased after midnight, and by dawn on the 5th, devastating ice accumulations of ½ to 1.5 inches were observed, with the hardest hit areas being along the I-85 corridor, from Anderson to Greenville-Spartanburg, to Gaffney. Hundreds of thousands lost power, and the outages lasted for as long as 2 weeks in some areas.*¹

Exhibit III-1 shows the effects of the storm on Duke's three regions as reflected by the number of customers off (experiencing power outages) by date.

¹ National Climatic Data Center (NCDC) Storm Events – South Carolina downloaded from <http://www4.ncdc.noaa.gov> on August 11, 2003; a national source of climatic information with data provided by the National Weather Service

Exhibit III- 1
Duke System Customers Experiencing Outages By Region



Source: Data Request 1-1

For Duke Power's Southern Region in South Carolina, the peak number of customer outages was 306,300.² The total number of customer outages eventually reached approximately 333,000.³ The area most affected by the storm in South Carolina was around the metropolitan areas of Greenville, Spartanburg and Anderson. **Exhibit III-2** identifies four of the hardest hit communities as measured by percentage of total customers experiencing outages.

² Data Request 1-1, dated August 4, 2003, from the PowerPoint presentation slide titled, "Duke Power Customer Outages – By Region"

³ Data Request 1-15

Exhibit III- 2
Communities Experiencing the Greatest Customer Outages

Community	Spartanburg	Greenville	Greer	Anderson
Maximum Number of Customers Experiencing Outages	99,943	115,285	25,823	27,250
Total Duke Customers (Data as of 3/1/01)	110,358	159,165	39,638	69,723
Percent of Total Customers	91%	72%	65%	39%

Source: Data Request 1-1, dated August 4, 2003, from the PowerPoint presentation slide titled, "Duke Power Customer Outages – By Region"

On January 8, 2003, six counties of South Carolina were declared major disaster areas due to the December 4, 2002 ice storm and were authorized to receive federal assistance for debris removal, emergency protective measures, and public utilities.⁴ The counties were Greenville, Spartanburg, Cherokee, Laurens, Union and York. Spartanburg and Greenville are the most densely populated among the six counties most affected by the storm.⁵ These areas coincide with those described by the National Weather Service as the hardest hit based on storm intensity.

Over the past ten years, the state of South Carolina (State) has experienced 31 events of ice or freezing rain as recorded by the NCDC Storm Events Database during the period January 1, 1993 through May 31, 2003.⁶ **Exhibit III-3** shows that in the past seven years Duke Power has recorded six ice storms that affected 20,000 customers or more.

Exhibit III- 3
South Carolina Ice Storms

Date of Ice Storm	Approximate Number of South Carolina Customers Experiencing Outages
2/2/96	83,000
1/9/97	47,000
1/2/99	229,000
1/23/00	177,000
12/4/2002	333,000
2/15/03 – 2/16/03	20,000

Source: NCDC Storm Events Database for South Carolina events reported between 1/01/93 and 5/31/2003 downloaded from <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent-storms> on August 11, 2003 and Data Request 1-15

⁴ FEMA news release dated January 8, 2003, from <http://www.fema.gov/news/newsrelease.fema?id=2129>, downloaded on October 12, 2003

⁵ U.S. Census Bureau Thematic Maps, TM-P002 Persons per Square Mile: 2000, downloaded from <http://factfinder.census.gov> on October 12, 2003

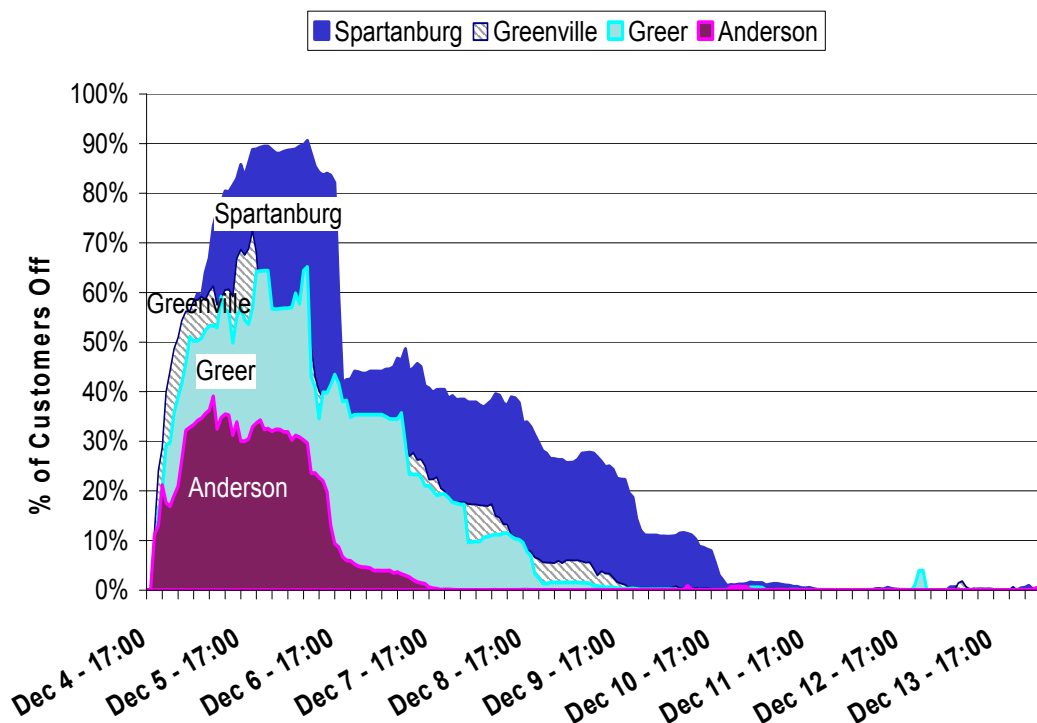
⁶ NCDC Storm Events Database for South Carolina events reported between 1/01/93 and 5/31/2003 downloaded from <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent-storms> on August 11, 2003

The Duke Power meteorologist estimated that Duke experiences major events every three to four years. And from years of experience, they know ice over ¼ inch causes damage to utility facilities, while ½- inch causes widespread damage to them. Within Duke’s South Carolina service territory, the areas north of I-85 on average have a higher chance of experiencing ice.⁷

Exhibit III-4 shows the South Carolina communities with the largest percentages of customers experiencing outages during the storm.

Exhibit III- 4

**Four South Carolina Communities Experienced
The Greatest % of Customer Outages**

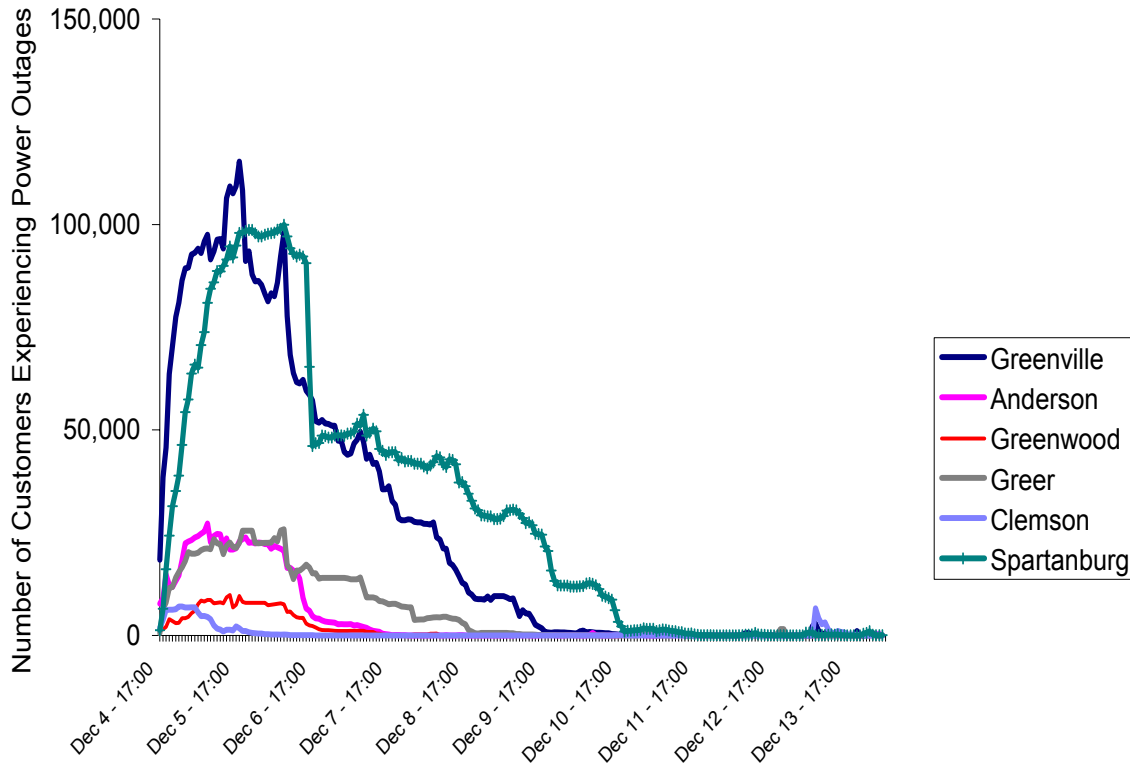


Source: Data Request 1-1, dated August 4, 2003, from the PowerPoint presentation slide titled, “Duke Power Customer Outages – By Region”

⁷ Interview with Nick Keener on August 21, 2003

Exhibit III-5 shows the number of Duke's South Carolina customers out of service by community as a result of the storm.

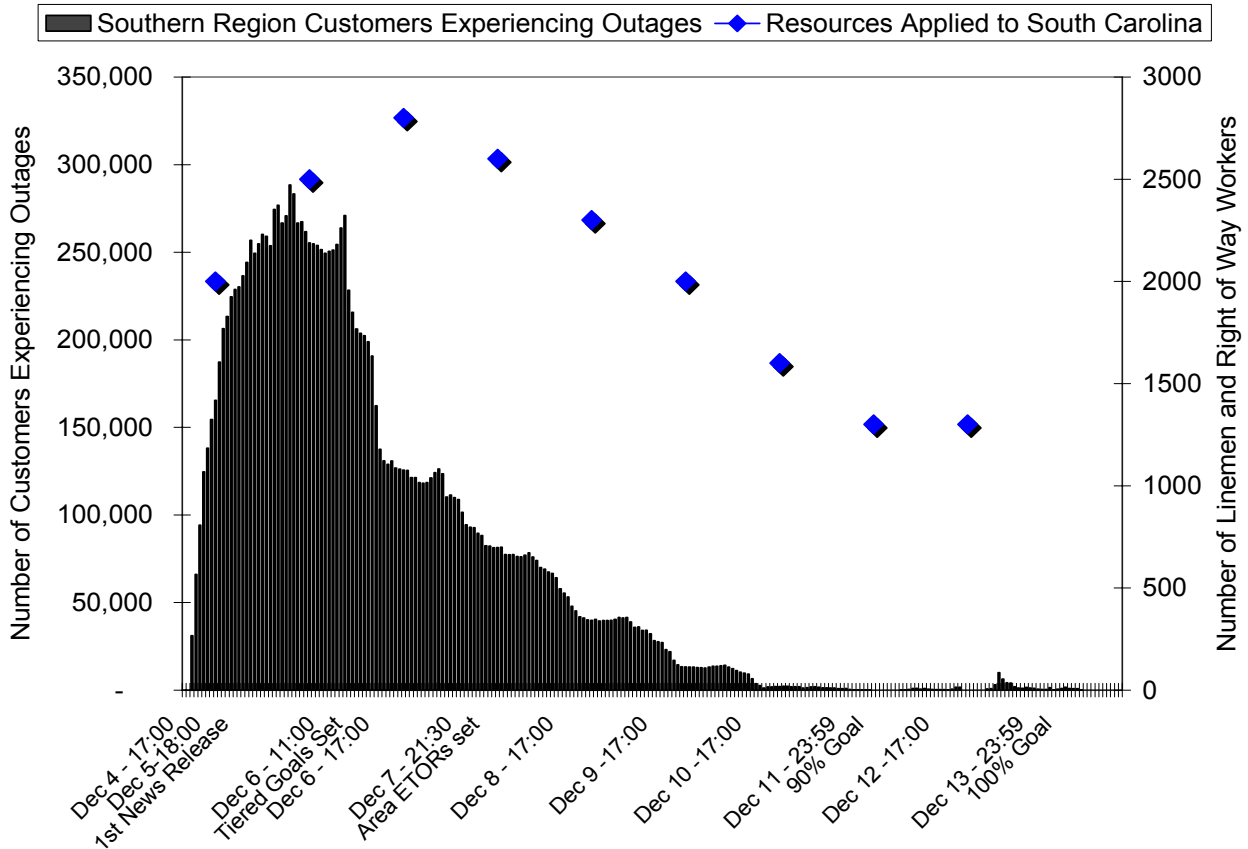
Exhibit III- 5
Customers Experiencing Outages by Community



Source: Data Request 1-1, dated August 4, 2003, from the PowerPoint presentation slide titled, "Duke Power Customer Outages – By Region".

Exhibit III-6 shows the number of resources, as supplemented by mutual assistance from other utilities, that Duke had available to respond to outages, as compared with the number of customers experiencing outages by day. About 48 hours elapsed between the time that the peak number of outages occurred and the time that the peak number of resources became available.

Exhibit III- 6
Volume of Restoration Resources Responding in South Carolina



Source: Data Request 1-1, dated August 4, 2003

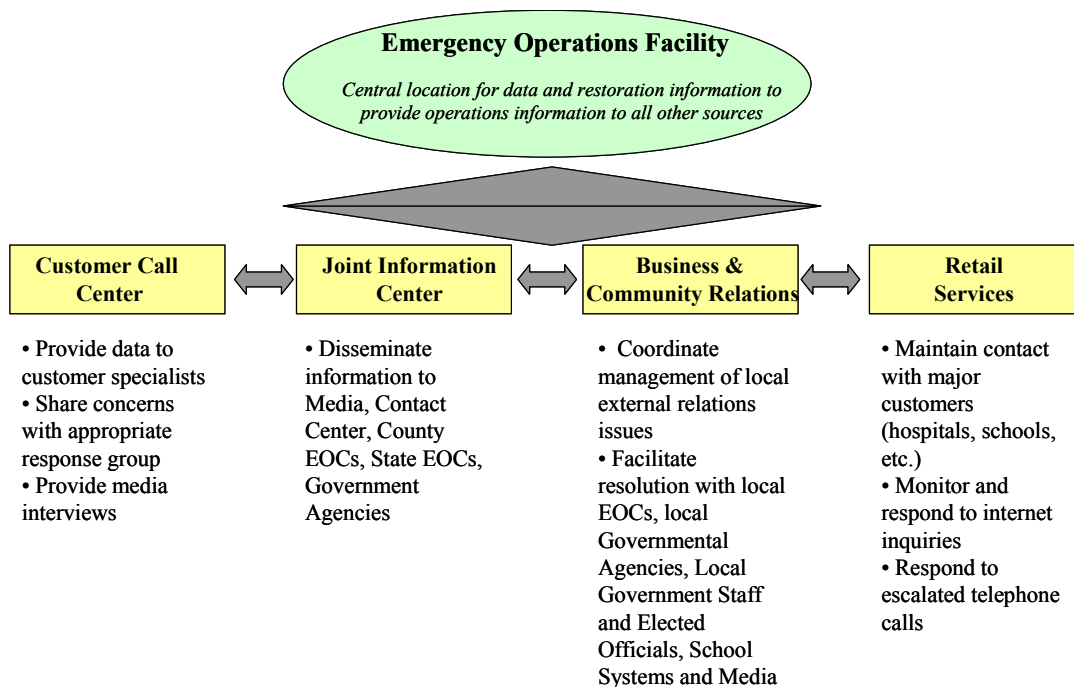
Duke Power implemented its external and internal communications plan beginning the week of December 2, 2002. The communications process employed during the December 2002 ice storm was supplemented by the creation of an Event Strategy Team that focused on the “strategy” Duke would take in functions such as external communications.⁸ This team took a high level view of the overall response to the storm, rather than being focused on specific activities and events. Duke began communicating with local and county governmental contacts

⁸ BWG interviews with Tim Petit, September 3, 2003 and Paige Layne September 3, 2003

about storm preparation as early as Monday, December 2, 2002 and continued communications throughout the storm. The Southern Region maintained communications via the public affairs department at the state level, district managers at the local level and account managers at the major customer level.

Exhibit III-7 shows the flow of information that occurs during an emergency.

Exhibit III- 7



Source: Second set of data requests from John Nelson, Joyce Steingass and Arun Mani, Page 67

The following timeline, excerpted from Duke's *Pre Storm Timing and Message Flow*, illustrates Duke's standard media relations activities during the course of a major storm.⁹

⁹ Pre Storm Media Timing and Message Flow

24-48 Hours Ahead of Storm

- News release
 - Meteorologists tracking path of storm
 - Pre-storm preparations
 - Preparation tips for customers
 - Safety
 - Consider home generator messages
- Web posting with news release information
- Request that Web team activate storm page for updates (if it appeared that storm would be significant)

12-24 Hours Prior to Storm Arrival

- Media advisory for media safety
- Officer team memo notification
- Web posting with news release information
- Press briefing considered if significant damage expected
- News release
 - Preparations continuing (logistics, planning, staging, etc.)
 - Supplemental help requested (other utilities, contract employees, etc.)
 - Customer preparation tips reiterated
 - Safety

Storm Day 1

- 1st news release
 - Areas affected
 - Assessment (how the utility investigates the storm-affected area and determines where to send repair crews)
 - Prepare 1-800-POWERON
 - Utility restoration crews available
 - Safety
 - Restoration process
 - Pertinent generation information
 - Assurances that the utility is ready
- Web site posting with news release information

Storm Day 2

- News release
 - Expression of appreciation for customer patience
 - Estimates of outages and expectations of additional outages
 - Estimates of restoration (broken into regions/ areas)
 - Any restorations made
 - Number of crews responding
 - 1-800-POWERON
 - Restoration process (Priority and process)
 - Safety
 - Shelter information
 - Peak outage numbers (when available)
 - Communications from Duke Power to customers – CSC, media, web
- Web posting with news release information
- Consider press briefings, helicopter tours, etc.
- Ensure significant rumors/ problems are addressed in advisories/ news releases

Storm Day 3 to End

- News release
 - Expression of appreciation for customer patience
 - Focus on progress
 - Weather is the enemy
 - Crews responding and working quickly and safely
 - Compliant crew/employees work
 - End in sight
 - Storm data/figures relating to the size and scope of the storm – number of poles, transformers, etc.
- Web posting with news release information
- Consider press briefings, helicopter tours, etc.
- Evaluate spokesperson touring affected areas, visiting regional EOCs, etc.

Wrap -up

- Final news release
 - Total number of customers affected over the event
 - More storm data/figures relating to the size and scope of the storm
 - Thanks to customers, employees, partner agencies
 - Total number of crews, outside assistance
 - Maybe projected cost
- Web posting with news release information

B. EVALUATIVE CRITERIA

BWG used the following evaluative criteria in this area:

- Did Duke have comprehensive emergency plans and procedures?
- Did these plans and procedures appropriately consider the communications interfaces with the media, state and local government officials, health and human service providers and other responders?
- Did the structure of the emergency organization support effective emergency response?
- Did Duke provide adequate training for its emergency response personnel in advance of the storm regarding their roles and responsibilities?
- Did Duke have an electric distribution system restoration procedure to prioritize its response that was commensurate with typical industry practices?
- Was accurate and sufficient information regarding estimated restoration times and storm restoration activities provided to customers, emergency preparedness entities and other organizations responsible for public health and safety?
- Did Duke conduct an adequate assessment of its response to the December 2002 ice storm in order to generate lessons learned and implement improvements?

C. WORK TASKS

In conducting this review, BWG consultants interviewed a large number of managers and engineers in various organizations who participated in responding to the December 2002 ice storm. We also prepared and submitted data requests, reviewed and analyzed Duke's responses to the data requests and made site visits to observe Duke's emergency operations facilities. BWG evaluated Duke's emergency preparedness in terms of three stages: (1) advance preparation including planning, organizing, and training; (2) emergency response during the storm event; and (3) post response actions such as developing and evaluating lessons learned and actions taken toward improving the Duke Power emergency plan.

D. FINDINGS AND CONCLUSIONS

1. Duke Power made an excellent tactical response to the December 2002 ice storm.
 - Duke began preparation several days ahead of the storm by alerting key personnel with advance weather warnings, holding emergency response team conference calls, contacting the Southeastern Electric Exchange (SEE) for outside assistance, and staging crews in field locations.
 - Duke is one of a few utilities with its own meteorological staff.¹⁰ The meteorological group assists with optimizing Duke's response to severe weather events. The Company receives reports from the National Oceanographic and Atmospheric

¹⁰ Interview with Nick Keener, August 21, 2003

Administration (NOAA), based on numerical models, through two satellite connections. The numerical models explain what is going on in the atmosphere. The meteorologist assists with emergency team conference calls and helps to interpret what to expect from storm severity. The first alert note with weather information went out to the Duke distribution list on Sunday, December 1, 2002.

- Based on the advance weather warning prepared by the Duke meteorologist, the storm restoration manager defined the event as a Level IV storm that would have more than 250,000 customer outages, and activated the Emergency Operations Facility on December 4, 2002.¹¹
 - Based on a prior agreement, the Emergency Operations Facility (EOF) operated by the Duke Power nuclear organization was available for Electric Distribution to use during the storm. The EOF is a spacious, well-equipped set of rooms with abundant telephones and up-to-date information technology. Duke also had designated an alternate location from which to operate in the event the primary location was not available.¹²
 - Duke began seeking assistance from other utilities in the Southeastern Electric Exchange on December 3, when the Company submitted a request for 400 linemen.¹³ Linemen and right of way resources in South Carolina numbered about 2,000 on December 5, and increased to a peak of about 2,700 on December 7.¹⁴
 - The volume of restoration resources lagged the number of outages by about 48 hours due to the fact that other utilities within the Southeastern Electric Exchange (SEE) did not deploy line crews in support of Duke until an assessment of the need in their own respective service areas was complete.
 - Throughout the nine-day restoration, safety was emphasized. Personnel and public safety was effective, even in face of the fact that thousands of linemen and right of way workers were engaged in the restoration. Tragically, one lineman from Florida Power and Light was killed in an automotive accident.
 - The supply chain worked efficiently. Duke experienced no difficulty acquiring the vast quantity of materials and tools needed to make repairs,¹⁵ which eventually included 3,200 new power poles, 549 miles of wire and 2,300 transformers.
2. Consistent with the best practices of electric utilities, Duke's response to the December 2002 ice storm was led by a fulltime emergency preparedness manager.
- Duke's Emergency Plan describes a command and control organization with specific emergency roles and responsibilities that are assumed by designated Duke personnel. Key roles are identified in such areas as storm restoration, support/logistics and

¹¹ Interview with Bob Meffert, August 19, 2003

¹² Site Visit to the Emergency Operations Facility on August 19, 2003

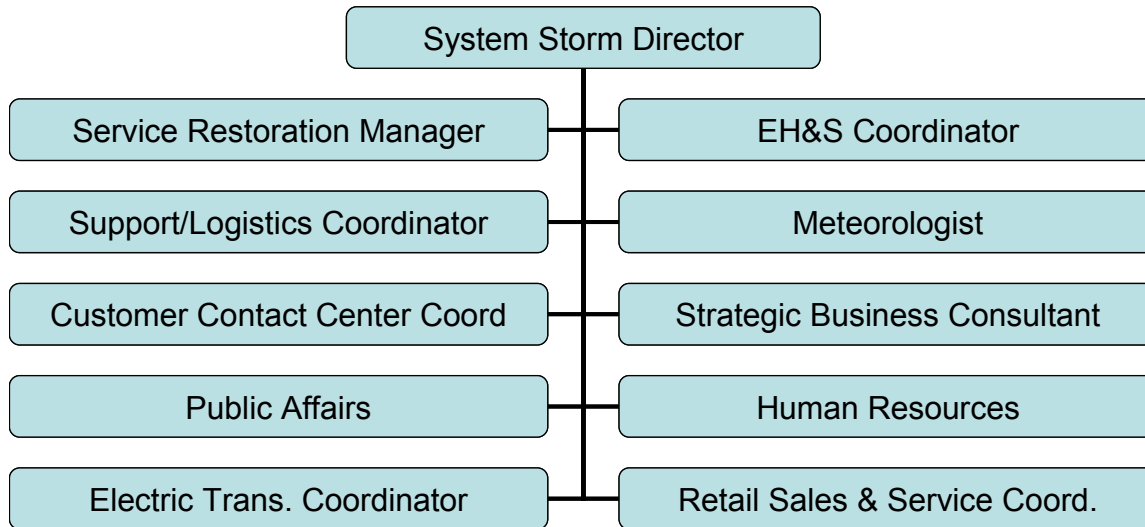
¹³ Data Request 3-38, "S.E.E. Resource Summary Sheet", as of 2:30 PM 12-04-02

¹⁴ Data Request 1-1, dated August 4, 2003, PowerPoint presentation slide titled "Resource Management"

¹⁵ Interview with Collier Hall on August 19, 2003

customer contact center coordination.¹⁶ **Exhibit III-8** is an organization chart showing the Emergency Operations Facility Organization.

Exhibit III- 8
Emergency Operations Facility Organization



Source: Initial Data Request, August 4, 2003, "Storm Restoration Procedures"

- The primary emergency response personnel, numbering about 12, attend training sessions and monthly planning meetings. Emergency Operations Facility performer training has been held on an annual basis for the past three years.¹⁷
 - Duke also participated in the Southeastern Electric Exchange drill exercises held during 2001 and 2002.¹⁸
3. Duke uses an appropriate restoration priority sequence that is common among electric utilities within the industry.
- Duke's storm restoration priority sequence consists of the following six priorities.¹⁹
 - 1) Public Safety-Related situations (e.g., "live" downed power lines);
 - 2) Emergency Services Facilities (e.g., hospitals, fire departments, police stations);
 - 3) Critical Infrastructure (e.g., water and sewer facilities);
 - 4) Distribution Feeders and Sub feeders;
 - 5) Distribution Lateral Tap Lines, followed by transformer outages; and
 - 6) Individual Service Line outages.

¹⁶ Data Request 1-1, dated August 4, 2003, PowerPoint presentation titled "Storm Restoration Procedures"

¹⁷ Data Request 2-15

¹⁸ Data Request 2-15

¹⁹ Data Request 1-1, dated August 4, 2003, PowerPoint presentation titled "Storm Restoration Procedures"

- Personnel who participated in the response to the December 2002 ice storm had a thorough understanding of the restoration sequence. This priority sequence is included in the basic training provided to Duke's linemen and other electric distribution operations personnel.²⁰
4. The outage management system that was in existence at the time of the December 2002 ice storm was inadequate, as were the processes for resource assessment and for developing and disseminating accurate estimates of service restoration times to the customers. (Recommendation 1)
- During the December 2002 ice storm, Duke used its Emergency Service Restoration (ESR) system to record and report outage information. The ESR is a mainframe-based program that was developed and implemented by the Company in about 1983.²¹ According to the ESR user manual, the primary function of the system is to: 1) rapidly record information from customers experiencing outages or some other problem with service; 2) associate those customers with the respective transformers and protective devices; and 3) analyze and report, based solely on telephone numbers, which transformers or devices are most likely to be out.²²
 - The ESR system performed throughout the storm without experiencing a computer system outage and operated at an average of over 1,000 ESR transactions per minute during the peak hours of December 5- 10, 2003.²³ Additionally, Duke adapted during the storm by making some on-the-spot changes such as creating additional reports of ESR data, for example, the number of customers affected and the number of customers calling on a circuit, so that it could apply resources to the worst hit areas. Duke also created a report to identify the schools that were without power.²⁴
 - The ESR system also has the capability to calculate and provide an estimated time of restoration (ETOR) for a device based on inputs such as weather, time of day and day of week. The ESR system handled the volume of calls received but was not designed to generate automated ETORs for an event of the December 2002 ice storm's magnitude.²⁵ The ESR system performs adequately on more normal day-to-day outages (typically lasting six to eight hours or less²⁶), and was not designed to handle events of the December 2002 ice storm's magnitude.²⁷ As a result, the ESR system could not generate ETORs that could be automatically communicated to Duke's customers. Thus, the Company was forced to develop ETORs manually.²⁸

²⁰ Interview with Collier Hall on August 19, 2003

²¹ Interview with Mike Royster on August 19, 2003

²² Data Request 3-9

²³ Data Request 3-16

²⁴ Interview with Mike Royster on August 19, 2003

²⁵ Data Request 3-16

²⁶ Data Request 3-17

²⁷ Interview with Mike Royster on August 19, 2003

²⁸ Interview with Mike Royster on August 19, 2003

- BWG believes the storm restoration team also had difficulty in providing ETORs to customers because Duke does not have a database or system to aid in developing resource estimates for large-scale restorations such as the ice storm. Resource estimates, which are essential in developing accurate ETORs, were collected and aggregated using mostly manual methods. Resource assessments were made based on the operational experience of Duke's personnel using a combination of Microsoft Excel spreadsheets, flipcharts, and information recorded on whiteboards in emergency centers.²⁹
- During the initial days of the restoration effort, Duke was not certain regarding the commitment of resources the Company would receive from other utilities in the SEE.³⁰ As mentioned previously, some line crews were not dispatched in support of Duke until an assessment of the need in their own respective service areas was complete.
- As a result of these deficiencies, estimated times of arrival (ETAs) in response to reports of downed power lines stopped being provided by call centers within hours after the storm began.³¹ ETORs were first provided forty-four hours after the beginning of the storm,³² and were characterized as targets or goals as indicated in
- **Exhibit III-9.**

Exhibit III- 9
Estimated Time of Restoration Targets

Tier I	All main feeders, public health and safety facilities restored by Monday, December 9.
Tier II	90 per cent of all customers restored by midnight Wednesday, December 11.
Tier III	Tier III – All services ready to be restored by 12 PM Saturday, December 14, revised to 12 PM Friday, December 13.

Source: Data Request 1-16, dated August 4, 2003.

²⁹ Interview with Bob Meffert on August 19, 2003

³⁰ Interview with Bob Meffert on August 19, 2003

³¹ Interview with City of Greenville Fire Chief on September 9, 2003

³² Data Request 1-16, Press Releases

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- At the storm's peak, about 306,300 South Carolina customers were without power. By the time that community specific ETORs were provided in a press release at 10:00 PM on Saturday, December 7, 2002, only about 82,000 or 25 per cent of the South Carolina customers were still without power.³³
 - Duke has a project underway to implement a new outage management system, called OutageLink, to replace ESR. The Company was piloting the new outage management database at the time of the December 2002 ice storm. The project schedule includes a system-wide rollout by the end of September 2003. The new system will provide the number of customers affected by outages, number of calls received by county, city, and zip code, and by Duke Power operating boundaries.³⁴
5. Duke may have understated the expected impact of the storm in its initial internal communications. (Recommendation 2)
- Although advance meteorological warnings provided a relatively accurate description of the approaching storm, the initial message included a disclaimer that indicated the forecast had low confidence. The first warning of the advancing storm, replete with meteorological terminology, may have been misinterpreted by the very people for whom it was intended. However, the meteorologist explained to BWG that the purpose of the "low confidence" phrase was to indicate that the event was a developing scenario and a forecast. Because the forecast was 72 hours out, confidence was determined to be low, especially with regard to the projected track of the storm.³⁵
 - Duke's procedures require the storm restoration team manager to designate the magnitude of the emergency by selecting the appropriate level from a predetermined list (Levels I-IV).³⁶ By definition, a Level IV exceeds 250,000 outages and thereby triggers a centralized system emergency response under the direction of the system storm director.
 - The template for region conference call requires an estimate of the number of outages that are expected to occur. However, according to the 10:00 AM conference call report for December 4, 2002, the projected number of outages was conservatively estimated at 250,000. Such information is essential to estimate the projected number of outage calls that will be made, determine how many customer service representatives will be needed to respond to those calls, and provide an early assessment of the volume of resources that will be needed to repair the system.
 - As a result, some organizations were less than optimally prepared during the early days of the storm. Customer service personnel recognized that they had more outages than the forecasted "250,000 outages" as early as the morning of December 5, 2002.³⁷

³³ Data Request JS 2-1, ESR Outage Data

³⁴ Data Request 1-17, lessons learned documents and project charters from the storm critique

³⁵ Interview with Nick Keener, August 21, 2003

³⁶ Data Request Q1 from Third set of data requests

³⁷ Interview with Sandra Meyer on August 19, 2003

- Since Duke did not accurately estimate the impact that the storm would have on customer outages, it may not have provided sufficient warning of the event's size to Duke's managers who were mobilizing resources to respond. To further illustrate this point, when Duke began seeking assistance from other utilities in the Southeastern Electric Exchange on December 3, the Company submitted a request for 400 linemen, but ultimately needed as many as 1,500 off system resources to respond.³⁸
6. Duke did not have pre-determined estimates of the number of scouts needed by zone. (Recommendation 3)
- As a part of Duke's immediate response to the storm, scouts were assigned to each area of the distribution system. Starting from the substation, the scouts patrolled their assigned areas and completed templates for damage assessment. Scouts were expected to patrol any area to which they were assigned, and were instructed to immediately report safety issues and stand by until these problems were resolved. Damage assessment records were turned in to scout coordinators in each area, who consolidated the information to use for resource assessments.³⁹
 - Field team leaders made decisions about what resources were needed and reported estimates to the respective area storm restoration centers. These aggregated estimates were then reported to the EOF. Field team leaders performed their own dispatching based on the crews assigned to them. Each night Duke made plans for the next day's resources and made work assignments of crews to each field team leader. The next morning work assignments were given to the crews along with job packets.⁴⁰
 - While Duke estimated that it used several hundred scouts during the storm, the Company could not provide an exact number of scouts employed because Duke does not maintain a single listing of all scouts.⁴¹ Each field location had a number of pre-identified scouts with varying backgrounds (engineers and technical skills specialists, etc.) and these scouts were either assigned to work at their normal work locations or were re-assigned as needed to other areas on the system that were impacted by the storm and in need of scouts. Others were taken from transmission or sales organizations depending on individual background or experience.

³⁸ Data Requests 1-1 and Q38 from the response to the Third Set of Data Requests from Joyce Steingass

³⁹ Interview with Bob Meffert, August 19, 2003

⁴⁰ Interview with Bob Meffert, August 19, 2003

⁴¹ JS-Q3 from the Third Set of Data Requests

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- While Duke generally used engineering personnel with an electric distribution background as scouts to perform damage assessments, Duke was unable to provide information that existed as of December 2002 demonstrating how scouts were trained to perform damage assessments.⁴² Prior to storm events, the scouts generally attended a training session on how to scout, but regardless, were provided a job aid to refresh them on the scouting responsibilities.⁴³
7. Adequate lines of communication between Duke and emergency services agencies were not established early enough to effectively manage the initial stages of the storm. (Recommendation 4)
- Most government agencies and emergency preparedness entities were satisfied with the communications from Duke during the storm. Representatives from the State, counties and cities reported that Duke communicated with them to their satisfaction and provided adequate contact through established relationships with the Company's District Managers.⁴⁴
 - The South Carolina Emergency Management Division office indicated that Duke was responsive in providing numbers of customers out of power, was open to their suggestions about restoration priorities, and provided timely information that was needed by the collective agencies in managing emergency situations.⁴⁵
 - Nevertheless, there were some significant problems that indicate opportunities for improvement.
 - Two of the three largest South Carolina cities that had extensive damage during the December 2002 ice storm experienced some difficulty contacting Duke during the first twenty-four hours of the storm.⁴⁶ One city public safety organization initially had only the 1-800-PowerOn number with which to report problems. A representative from that organization indicated there was also a lack of estimated arrival times at downed power lines.⁴⁷
 - The Fire Chief from the City of Greenville mentioned that there was not sufficient feedback on Duke's service restoration plans prior to the storm.
 - The Chief of Preparedness and Response from South Carolina Emergency Management Division mentioned that there were counties that did not know how to contact Duke during the first twenty-four hours of the storm.

⁴² JS-Q2 from the Third Set of Data Requests

⁴³ Interview with Mr. Meffert on August 19, 2003

⁴⁴ Interviews with Mr. Paolucci, Ms. Solesbee, Mr. Thompson, Chief McDowell, Mr. Edwards, and Chief Fisher

⁴⁵ Interview with Mr. Paolucci on September 25, 2003

⁴⁶ Interview with City of Greenville Fire Chief on September 9, 2003

⁴⁷ Interview with City of Greenville Fire Chief on September 9, 2003

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- The lack of contact resulted in some increased safety risk to one city's fire rescue crews. Because of the amount of downed trees and downed power lines in the city of Greenville, the Fire Department had a rescue truck preceding the response trucks to clear the roads and the rescue crews used hot sticks to move power lines.⁴⁸
8. While Duke took the initiative to develop lessons learned, the Company may not have adequately followed through. (Recommendation 5)
- Within weeks following the storm, in December 2002, Duke effectively took the initiative to solicit feedback for improving its emergency plans with the Company, city, and county organizations and promptly began initiating some of the recommended changes.⁴⁹
 - Duke also initiated a December 2002 Ice Storm Critique, which identified over 852 items that were divided into four categories: quick fixes, short-term actions, long-term actions, and no action necessary. Critique presentation documents indicated that the latest of the implementation dates scheduled for these actions was December 31, 2004. However, Duke reported that 777 of the actions were complete and the remaining 75 were transferred to the appropriate business units for completion.⁵⁰ Open items include such things as the Duke Energy Resource and Skill data base, drill scenarios, benchmarking the best practices of other utilities, developing ETORs by political boundary, resource management tools, and enhanced damage assessment technology.
 - Despite damage to 3,200 distribution poles, Duke did not perform a formal failure analysis that would be expected from an event of this magnitude.
 - For example, Duke did not perform a thorough and documented analysis to confirm whether any distribution poles failed due to ice loading.⁵¹
 - Duke has not undertaken any studies that might involve recommending what actions Duke can take to prevent damage caused by accumulations of ½-inch ice during a storm nor has it done studies on storm proofing.⁵²
 - The Company did not document storm restoration efforts at the pole-by-pole level,⁵³ which would have provided information such as whether crews found it necessary to replace damaged poles with larger or stronger poles.
 - Duke did not perform any analysis to confirm whether or not any distribution poles broke due to structural loading related to joint facilities.⁵⁴

⁴⁸ Interview with City of Greenville Fire Chief on September 9, 2003

⁴⁹ Interviews with cities, counties, and South Carolina Emergency Management Division, September 2003

⁵⁰ Data Request 1-17, Lessons Learned documents

⁵¹ Data Request JS 9-25 Q7 and interview with David West on September 23, 2003

⁵² Interview with Mr. Keener on August 21, 2003

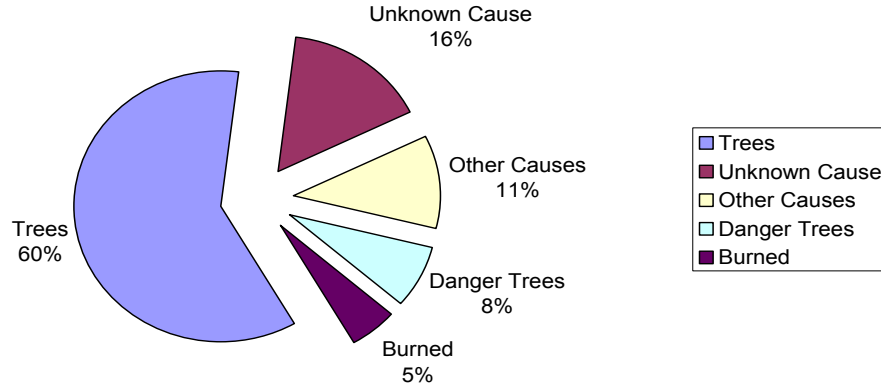
⁵³ Data Request JS 9-25 Q4

⁵⁴ Data Request JS 9-25 Q8

- Duke did not retain some of the documentation created during the storm restoration effort, such as EOF communication logs, resource estimating worksheets⁵⁵ and the scout damage assessment records.⁵⁶ This raises doubts regarding the thoroughness of the lessons learned efforts and suggests that the Company may not have sufficiently identified all of the measures that could be taken to prevent or minimize damage from a future event.
- As indicated in **Exhibit III-10**, “trees” and “danger trees” were together responsible for about 68 per cent of the causes for outages during the storm. Because so many of the outage causes were attributed to trees, it is not unreasonable to expect that Duke would attempt to determine what preventive steps could be taken to avoid such extensive tree damage in a future ice storm. Duke stated that the Company is not aware of any studies by entities such as the U.S. Forestry Service related to storm damage caused by ice loading of trees.⁵⁷ Further, BWG did not find an action item related to vegetation management in the lessons learned project charters nor in the project deliverable action plans.⁵⁸

Exhibit III- 10

**Percentage of Customers Affected - By Cause
(Outages Affecting > 500 customers)**



Note: “Other Causes” included: Broken, Planned Outage, Overload, No Problem Found, Fail to Reclose, Relay Blocked, Melted, and Cause Code EX

Source: Data Request 3-3, data from the Excel file titled “Q-Inlist OMS History B Dec 2002.xls”

⁵⁵ Data Request JS 9-5 Q4

⁵⁶ Data Request JS 9-5 Q2

⁵⁷ Interview with the vegetation management group, August 20, 2003

⁵⁸ Data Request 1-17

E. RECOMMENDATIONS

1. Improve the systems and processes used to develop and communicate ETORs to the customers during storms and take advantage of tools and technology available to automate resource management. Duke should continue efforts already underway to correct these deficiencies. (Conclusion 4)
 - Duke's Phase II Project Deliverables for Information and Operational Enhancements Item #1 indicates that making improvements to communicating ETORs is an action item that should be addressed upon full implementation of the OutageLink system expected by September 30, 2003. Further, Duke expects that the recommended voice response unit (VRU) project will provide additional ETOR enhancements.
 - Duke's Phase II Project Deliverables for Information and Operational Enhancements Item #2 indicates that Duke is developing a resource management tool to allow crew documentation; detailed tracking and documentation of crew movement; GIS tracking and transfer of information to state/federal agencies.
2. When preparing for weather related events, enhance the method used to forecast the volume of outages and the resources needed for restoration. For example, in addition to designating an event as "affecting greater than 250,000 customers" and labeling it a category IV storm, prepare a detailed estimate of the number of outages expected as well as the corresponding resources required for restoration. (Conclusion 5)
3. Develop a process for identifying and assigning scouts and field team leaders to specific areas and pre-stage these resources ahead of major events. Determine the number of scouts necessary to perform damage assessments by map grid or circuit for each zone for large-scale restorations. (Conclusion 6)
4. Continue to proactively reach out to counties and major municipalities to inform and educate customers regarding the Company's emergency plans and what to expect during major storms. (Conclusion 7).
 - Explain to customers the service restoration process and priorities.
 - Provide a more accurate estimate of Estimated Time of Restoration (ETOR) to its customers.
 - Describe the customer's repair responsibilities (e.g., "If the meter is pulled away, then it is the customer's responsibilities to have an electrician fix it.").
 - Strengthen liaison with county emergency preparedness by attending area meetings periodically and by sending a representative to County EOC to coordinate communications.
 - Work with county emergency preparedness officials to update Duke's emergency plan with current critical facilities.

-
- Duke has actively implemented several initiatives to increase the level of communications with emergency management officials, local government leaders, school systems, public health and safety organizations and other utilities.
 - Established a Single Point of Contact (SPOC) on a county-by-county basis throughout the service territory. During emergencies that result in customer power outages, the SPOC's sole responsibility is to coordinate the flow of information between Duke and their assigned organization (i.e., local government leaders and school systems).
 - Established a County Communicator role to coordinate with local government officials. Duke is still working on details regarding this role.
 - Reached out to key emergency response stakeholders to identify areas where communication channels could be enhanced. Duke will be participating in and/ or facilitating semi-annual discussions with key emergency response stakeholders prior to the major Carolina region storm seasons for hurricanes and winter storms.
5. Modify lessons learned procedures and document retention policies in order to provide for more thorough investigations of storms and other emergency events and ensure the implementation of corrective actions identified. (Conclusion 8).
- Enhance the data collection, data consistency, and analysis of outages and failures during storms to provide more information on causes and preventive solutions.
 - Retain key storm documentation to enable following analyses.
 - Perform formalized failure analyses to determine causes of extensive system damage.
 - Investigate actions that can be taken to prevent damage to electric facilities caused by accumulations of ice.
 - Communicate action plans for lessons learned and improving emergency plans by clearly identifying the designated sponsor and assigning sufficient authority to assure implementation. Perform frequent status updates to ensure action is taken.

CHAPTER IV

Electric Distribution System Management

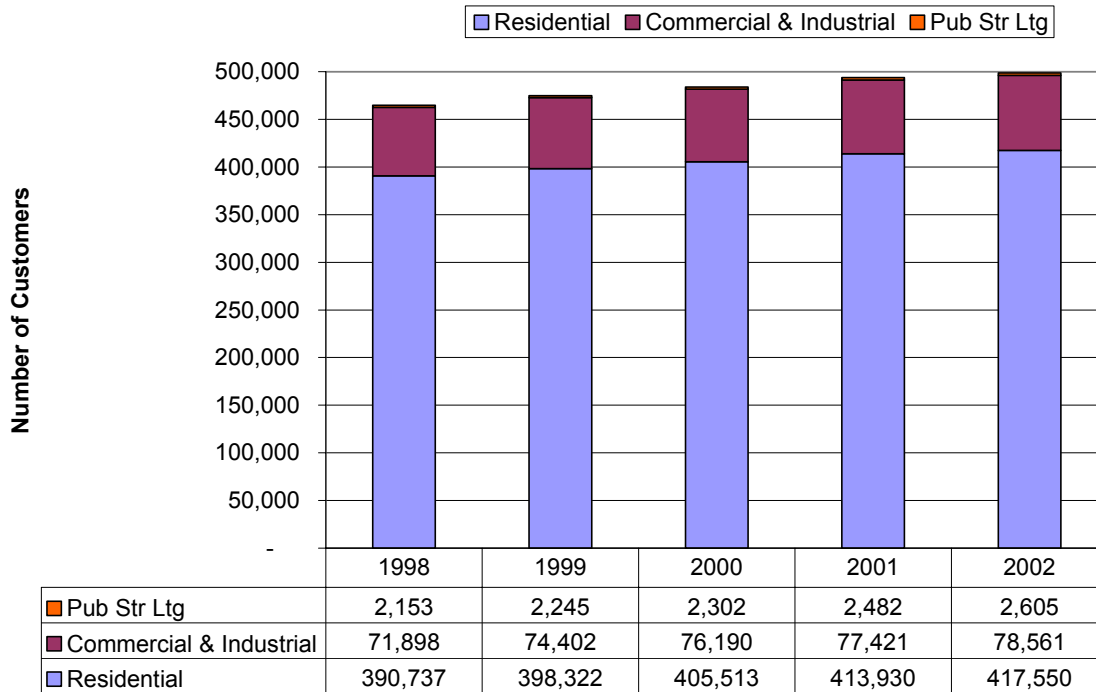
This chapter evaluates the policies and practices employed by Duke Power (Duke or the Company) in the management of its electric distribution system. The assessment was based on a review of organizational relationships within and among the departments responsible for managing electric distribution functions and resources, the management processes and practices employed and the metrics used to evaluate the performance of the electric distribution organization and its assets. Although the audit focused primarily on the December 2002 ice storm, BWG also reviewed events leading up to the storm, as well as policies and practices that impacted the Company's ability to respond to the outages that occurred.

A. BACKGROUND

Duke Power generates, transmits, distributes and sells electricity in a service area covering about 22,000 square miles with an estimated population of 5.7 million in central and western North Carolina and western South Carolina. About one quarter of the customers are in South Carolina. Duke's territory is composed of urban, suburban and rural areas. The major urban areas are located along the Interstate 85 highway corridor and include large cities such as Greenville and Spartanburg in South Carolina and Charlotte, Durham and Chapel Hill in North Carolina. Duke also serves a large number of smaller cities in both states, as well as many rural areas. Many of Duke's commercial and industrial customers occupy land adjoining the major inter-city highways. The bulk of the customers are located in the cities and towns and in suburban residential tracts. The terrain in both states includes a mixture of flat, hilly and mountainous areas. Much of the territory is heavily populated with large trees.

Duke's electric distribution system is composed of approximately 64,000 miles of overhead primary and secondary distribution lines and about 25,000 miles of underground distribution lines. Twenty-five to thirty percent of the lines are located in South Carolina, where the Company experienced customer growth of about seven percent during the years 1998-2002, as shown in **Exhibit IV-1**. This represents an average customer growth of almost two percent per year.

Exhibit IV - 1
South Carolina Customer Growth



Source: Data Request 2-52.

B. EVALUATIVE CRITERIA

BWG used the following criteria to evaluate the management of Duke's electric distribution system:

- Does Duke have a well-defined organizational structure that effectively incorporates the planning and implementation of maintenance programs and capital investments?
- Is the distribution organization structure effective in helping Duke meet its goals and objectives for providing service to its customers?
- Is Duke's electric distribution organization appropriately staffed?
- Does Duke utilize an effective manpower planning program to indicate the optimum number of skilled people needed to match the demands of the electric distribution workload?

- Did the electric distribution staff have adequate background and training to perform the work?
- Does Duke use appropriate service reliability metrics for measuring and managing investments and capital programs for reducing outages and improving reliability?
- Does Duke adequately measure system performance (SAIDI, SAIFI, CAIDI) in order to target areas for improvement?
- Does Duke's T&D system reliability management program focus on root causes of problems impacting reliability?
- Have Duke's capital and operating and maintenance funding levels been appropriate?

C. WORK TASKS

In conducting this review, BWG consultants interviewed a large number of managers and engineers in various electric distribution organizations, prepared and submitted data requests, and reviewed and analyzed Duke's responses to the data requests. BWG focused on the business plans, goals and objectives, organization, budgeting, staffing, manpower planning, employee incentive compensation programs, policies and procedures, and training of the Duke Power organizations having responsibility for managing the electric distribution system. We also reviewed the performance and reliability of the electric distribution system.

D. FINDINGS AND CONCLUSIONS

1. Duke has made a number of changes in the organizational structure of its electric distribution organization regarding system ownership, responsibilities and objectives during the late 1990's and early 2000's. (Recommendation 1)
 - The electric distribution organization structure that existed at Duke in the 1980's and early 1990's was based on the concept or philosophy that each geographic division or area should contain the functions and activities necessary to support the effective execution of all electric distribution functions. Four division vice presidents were each in charge of line management and most decisions were made within the line organizations. The general office was in charge of establishing standards. Both the operations and maintenance and customer service functions reported to the same business unit.¹
 - During 1995, a team was formed to recommend organizational changes, which were then implemented during 1996. A key driver for the restructuring was the new billing system, which required a greater level of consistency within the operations. The retail customer services organization emerged as a separate business unit in order to focus more attention on marketing and customer care.

¹ Interview with Rob Manning on August 19, 2003

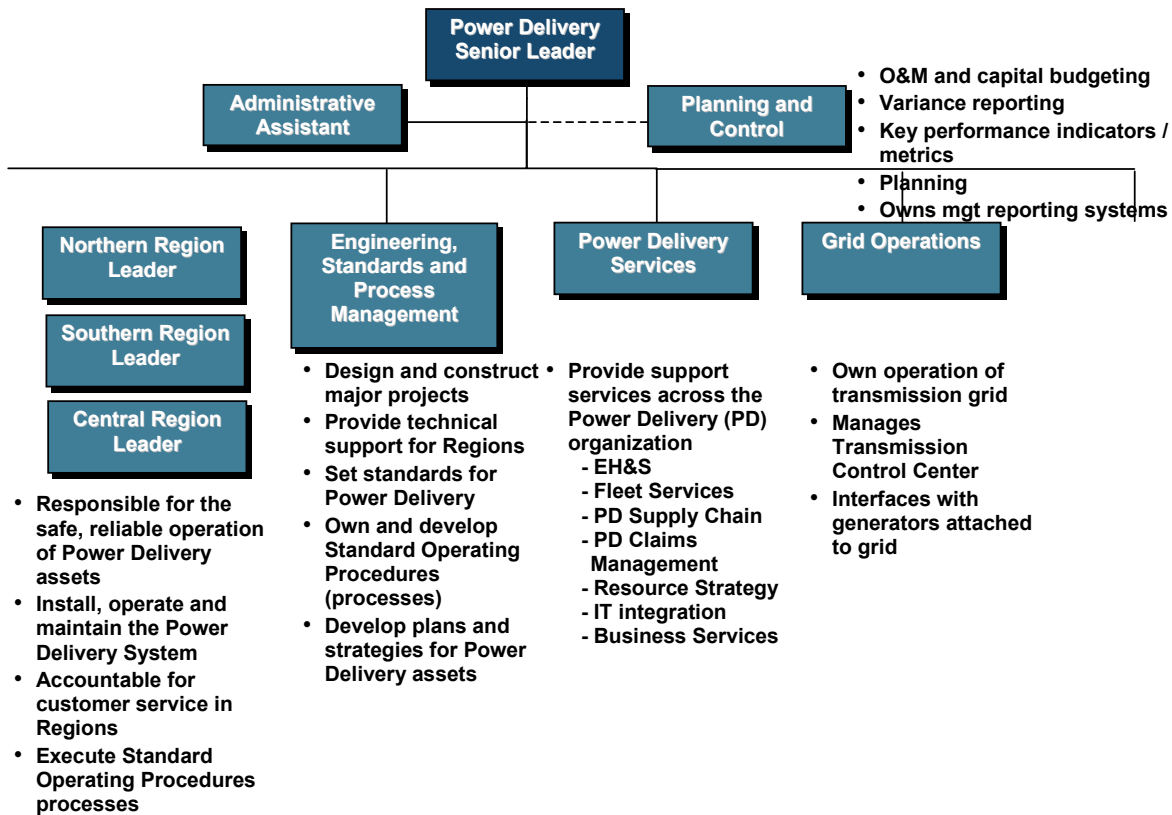
The electric distribution organization was responsible for operating and maintaining the system. The organization was structured in five core business processes:²

- 1) Market strategies
 - 2) Acquire and maintain customers
 - 3) Provide reliability and integrity
 - 4) Deliver products and services
 - 5) Bill and collect revenue
- The process-based structure that replaced the area organization in 1995-96 may have created a gap between the electric distribution organization, which was technically oriented, and the retail organization, which was marketing and customer service oriented. Three of the five processes that were created were marketing and customer service oriented, and only two were distribution oriented.
 - Another drawback to the move to core processes was the implementation of a matrix form of organization which can be more complex to understand and operate than a traditional line reporting structure. Following the 1996 restructuring the craft workers (e.g., line crews and troublemen) were dedicated to each process and separate skill sets were delineated for them.
 - During 2000, Duke added a vice president to whom the five business process owners reported. However, the separation of the retail business from electric distribution system operation and maintenance remained.
 - Duke's most recent organizational change occurred in August 2003. The current structure is shown in **Exhibit IV-2**. The primary objectives of the reorganization included: 1) combining distribution and transmission, 2) continuing the leveraging process for operational efficiencies and consistency, and 3) increasing the level of operational responsibility for the regions while continuing to ensure consistency and sharing of best practices.³

² Interview with Rob Manning on August 19, 2003

³ Interview with Barbara Orr on September 25, 2003

Exhibit IV-2 Current Duke Power Delivery Organization



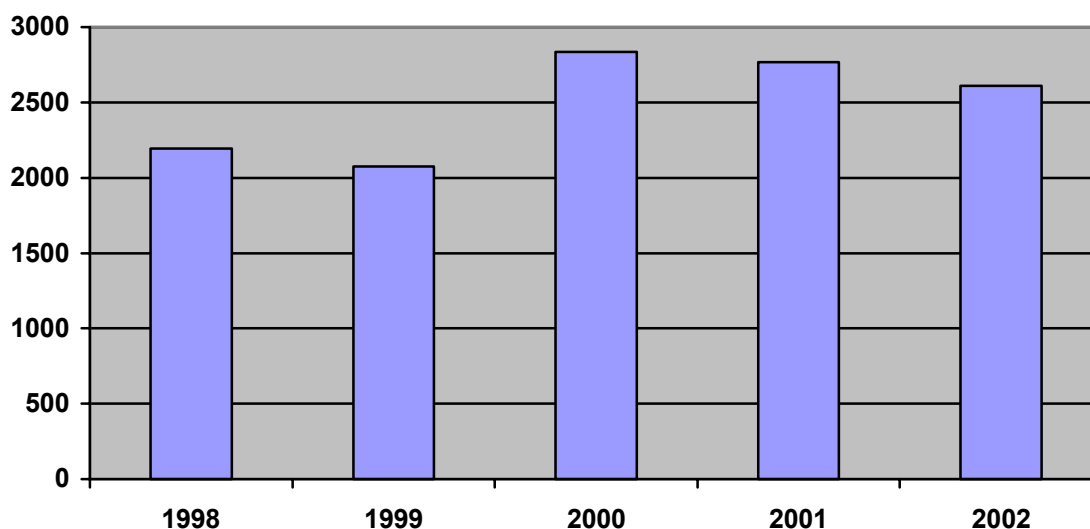
Source: Data Request 3-21, from the diagram of the new Power Delivery organization.

- This reorganization change brings electric distribution back to the area orientation that had existed in the early 1990's. Line managers are once again responsible for most of the decision-making processes and are accountable for managing all work other than centralized activities and major projects.
2. Employee incentive compensation programs for Duke's electric distribution personnel favor earnings over reliability. (Recommendation 2)
- It appears that the 1995-96 move to a process-based organization also reoriented goals and objectives toward profits instead of reliability. Duke was not able to provide information regarding goals and objectives prior to 1998; however, BWG's analysis of employee incentive compensation measures for the years 1998 through 2003 indicate the following.
 - From 1999 through 2003 employee incentive compensation measures were predominantly based on economic considerations, such as earnings per share

(EPS) and earnings before interest and taxes (EBIT). These measures accounted for fifty percent of total incentive compensation from 1999 through 2002 and seventy percent in 2003.

- Reliability oriented measures ranged from five to twenty percent during same period.
3. Staffing levels for Duke’s electric distribution organization are not adequately based upon quantified data. (Recommendation 3).
- Exhibit **IV-3** depicts the staffing levels of Duke’s electric distribution organization during the years 1998-2002.

Exhibit IV-3
Electric Distribution Staffing Levels (1998-2002)



Source: BWG 1-9

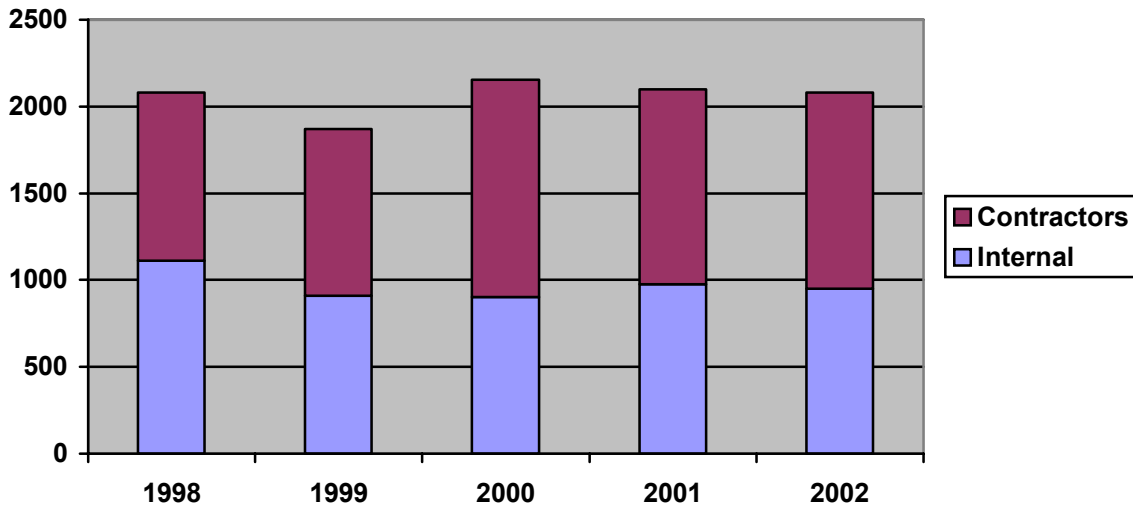
- As the exhibit shows, staffing levels declined about five percent from 1998 to 1999, due to a voluntary severance program intended to reduce headcount and lower costs. Duke has undertaken several such workforce reduction programs in recent years,⁴ all of which amounted to a very small percentage of the total workforce at the time. It is not likely that any of these downsizing efforts significantly impacted the effectiveness of the operating and maintenance workforce. Nonetheless, there is no indication that the decisions to proceed with any of these downsizing efforts were supported by a quantified analysis of

⁴ Data Request JS 9-5 Q24

workload versus the work force that was expected to be retained in order to ensure that the remaining work force would be sufficient.

- Electric distribution staffing levels increased by approximately 37 percent from their lowest point in 1999 to their highest level in 2000. The change resulted in part from the movement of the fleet services, supply chain, facilities management and real estate groups into electric distribution. Additionally, employees in the former Nantahala Power and Light Company were integrated into their related Duke Power organizations.⁵ Following that increase, electric distribution headcount decreased by about eight percent from 2000 to 2002 to a level of about 2,600, which is still almost twenty percent above the 1998 level.⁶
- The electric distribution organization has also made extensive use of contractors during the last several years. **Exhibit IV-4** shows the estimated number of Duke employees, including line technicians, meter technicians, field service representatives and distribution service technicians for each of the years during 1998-2002. It also shows the estimated full time equivalents of contractors used.

Exhibit IV-4
Contractor Staffing Levels
(1998-2002)



Source: Data Request 3-5

⁵ Data Request 3-4

⁶ Data Request MJ 9-5 Q4

- On an on-going basis, Duke uses contractors to ramp-up or ramp-down the workforce based on workload projections from the Company's work management systems.⁷ This practice has allowed the Company to avoid having to layoff Duke linemen.⁸ Over the past several years Duke has also outsourced lower skilled work such as meter reading, non-climbing service work, and facility locating. Additionally, the Company has used contractors for more specialized work such as tree trimming, maintenance, and construction.
 - Duke uses several work management tools for estimating, planning and scheduling routine work, mid-sized projects and large projects. These tools are used to manage the operations, maintenance, and construction workforces, but do not include estimating, engineering, or other technical staff.⁹ The Routine Work Management System (RWMS) is generally used for day-to-day routine work typically for one-person crews. Another system, called WorkLink is used for work sized in the range of greater than two hours to about two weeks. Large projects are usually managed with other project management software packages such as Microsoft Project.
 - Duke uses these tools to identify only short-term resource needs, usually a few weeks into the future. No long-term (i.e., quarterly or annual) projections of resource needs are prepared.¹⁰ The total amount of work identified (work backlog) is available through reports that can be generated from Duke's work management systems. However, Duke does not monitor work backlog, so it has no means of determining whether the total amount of work identified is increasing, decreasing or remaining the same. There is also no comparison of actual work accomplished versus that scheduled. As far as performance is concerned, a thirty hour per week "rule of thumb" is used for planning, but neither individual nor overall workforce utilization and productivity are measured.
4. Duke's technical training program is adequate.
- Duke appropriately identifies the job skills training needed for the Company's line crews and has developed corresponding course modules.
 - The Company uses a matrix to track and monitor mandatory training for its electrical workers, in order to comply with safety, environmental and other regulatory requirements related to electrical workers.¹¹
5. Since the early 1990's, Duke exercised cost control and reduction policies that may have resulted in less than adequate funding of its South Carolina electric distribution system. (Recommendation 4)

⁷ Data Request MJ 9-5 Q5.

⁸ Interview with Barbara Orr and Jim Murphy on September 25, 2003

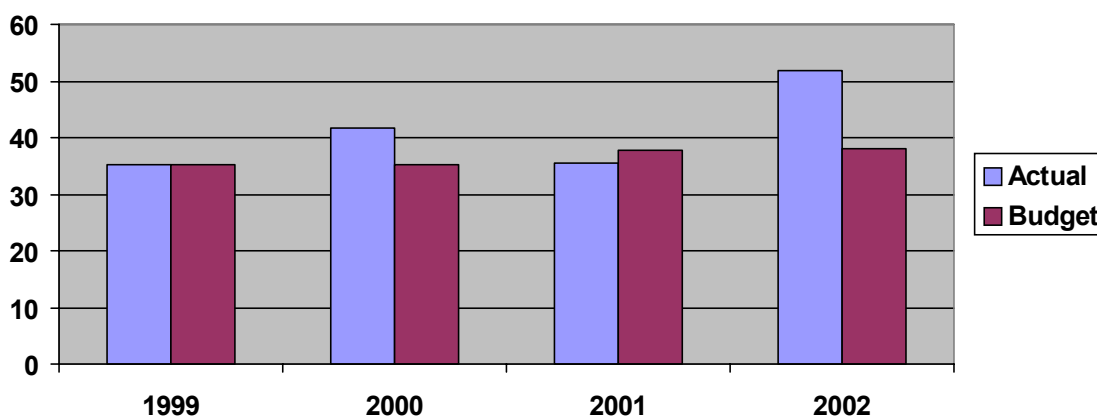
⁹ Interview with Barbara Orr on September 25, 2003

¹⁰ Interview with Karen Robb on September 30, 2003

¹¹ Data Request JS 9-5 Q36

- As depicted in **Exhibit IV-5**, from 1999 through 2002, Duke’s operating and maintenance (O&M) budget for its South Carolina electric distribution system was relatively flat, varying less than three million dollars from \$35.1 million in 1999 to \$38.0 million in 2002. As the exhibit shows, actual expenditures exceeded budgeted in every year except 2001. If expenditures associated with the response to the December 2002 ice storm (\$16.5 million) were excluded, actuals in that year would also be under budget.¹²

Exhibit IV-5
SC Distribution System O&M Budget
(\$million)



Source: Data Request 1-5

- As shown in **Exhibit IV-6**, South Carolina O&M expenditures have grown approximately the same rate as Duke’s total O&M expenditures. Duke’s total O&M expenditures increased slightly more than thirteen percent from 1998 to 2002, while South Carolina expenditures increased almost fifteen percent.

Exhibit IV-6
O&M Expenditures
(\$million)

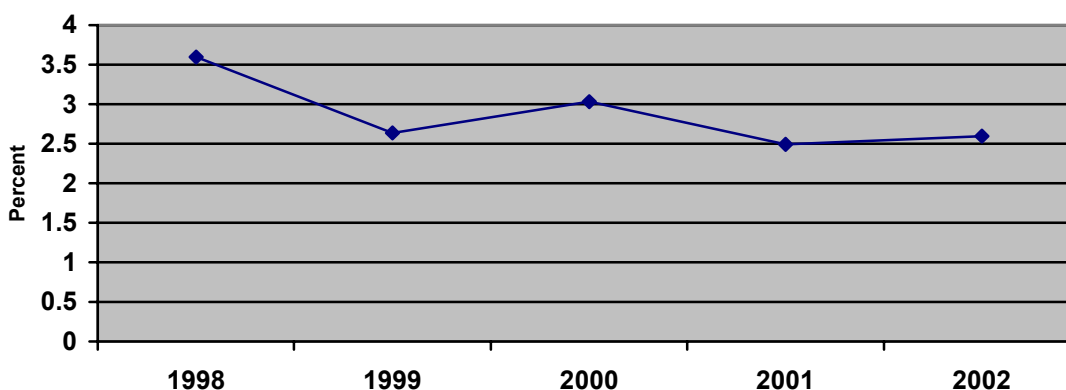
	1998	1999	2000	2001	2002	Percent Increase
SC Distribution	45.1	35.3	41.6	35.4	51.8	14.9 %
Duke Power Total	1252	1337	1375	1419	1441	13.1 %

Source: Data Requests 3-2 and 3-3

¹² Data Request 1-20

- However, when expressed as a percentage of Duke's total O&M expenditures, the South Carolina portion has actually declined. **Exhibit IV-7** shows that when the December 2002 ice storm restoration costs are excluded from both Duke's total and South Carolina's O&M costs, the South Carolina portion of Duke's total O&M expenditures declined during the last several years.

Exhibit IV-7
South Carolina O&M Expenditures as a Percentage of Duke's Total



Source: Data Requests 1-20, 3-2 and 3-3

- A similar pattern exists with regard to Duke's South Carolina capital expenditures. As depicted in **Exhibit IV-8**, while Duke's total capital budget increased by more than eighty percent from 1999 to 2002, the South Carolina portion increased less than twelve percent.

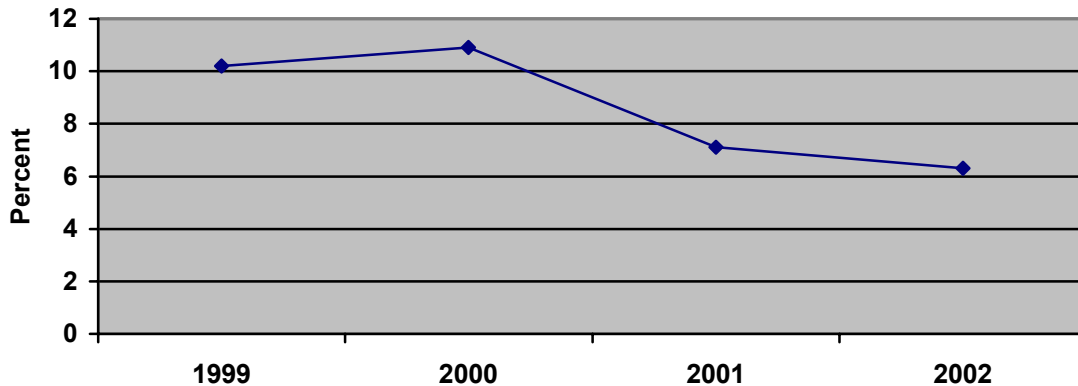
Exhibit IV-8
Capital Expenditures
(\$million)

	1999	2000	2001	2002	Percent Increase
SC Distribution	70.3	78.5	77.2	78.6	11.8 %
Duke Power Total	690.4	719.2	1,082	1,249	80.9 %

Source: Data Requests 3-6 and 3-8

- Further, as shown in **Exhibit IV-9**, the South Carolina Distribution System's portion of Duke's total capital expenditures declined steadily from 1999 through 2002. In 1999, the South Carolina portion represented just over ten percent of the Duke Power total. By 2002, it accounted for only 6.3 percent.

Exhibit IV-9
South Carolina Capital Expenditures as a Percentage of Duke's Total

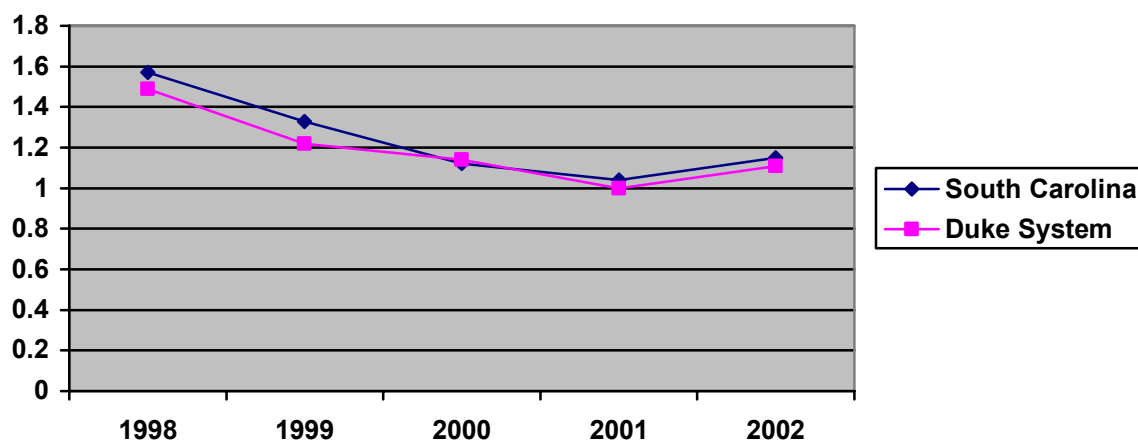


Source: DR #5 and DR #6

- It is not clear why expenditures in South Carolina fell behind those for the rest of Duke's system. Throughout the period, Duke had adequate budgeting tools and procedures in place. The level of funding for the electric distribution system was the result of a conscious and concerted effort. Budget call letters and other guidance in two of the years were clear and specific with regard to requiring a reduction in expenditures and maintaining costs at the lowest possible level in order to promote growth in earnings before interest and taxes.¹³
6. The reliability of Duke's electric distribution system declined in 2002 following several years of improvement. (Recommendation 5)
- Duke's electric system reliability, as measured by three indexes that are commonly used throughout the electric utility industry, showed mostly favorable trends from 1998 through 2001, then all declined in 2002. None of these indexes were affected by the December 2002 ice storm since all major outages are excluded from the data.
 - System Average Interruption Frequency Index (SAIFI) is an indication of the number of times per year that the average customer experiences an outage. **Exhibit IV-10** shows that Duke's SAIFI, both for South Carolina and the total system, decreased from 1998 to 2001, and then increased in 2002.

¹³ Data Request MJ 9-5 Q1

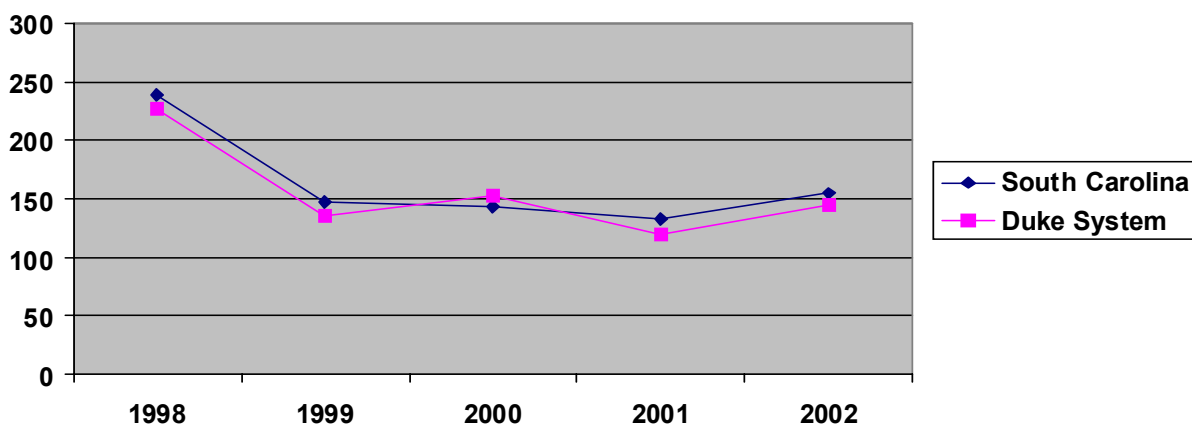
Exhibit IV-10
SAIFI



Source: Data Request 1-22

- System Average Interruption Duration Index (SAIDI) is the average outage duration for all customers in the system. As shown in **Exhibit IV-11**, annual reliability report data indicate that from 1998 through 2001, the average duration of Duke's outages decreased. SAIDI for both South Carolina and Duke's total system increased in 2002.

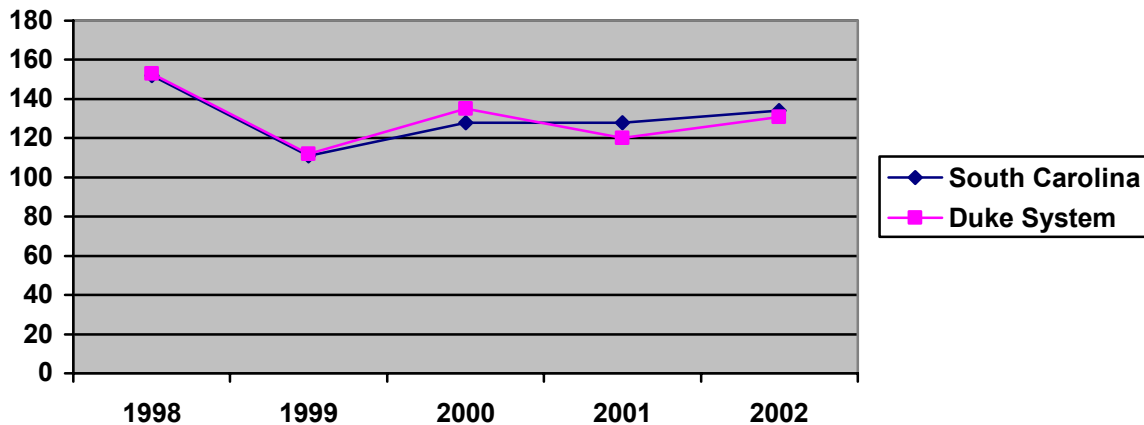
Exhibit IV-11
SAIDI



Source: Data Request 1-22

- For those customers that do experience an outage, Customer Average Interruption Duration Index (CAIDI) measures the average duration that they were without power. As shown in **Exhibit IV-12**, South Carolina CAIDI began increasing in 1999 and has maintained this trend. Duke's total system CAIDI, similar to South Carolina, improved from 1998 to 1999, but is higher in the three subsequent years despite an improvement in 2001.

Exhibit IV-12
SC CAIDI



Source: Data Request 1-22

E. RECOMMENDATIONS

1. Maintain the area-based organization that currently exists.
 - Duke will undoubtedly face numerous challenges and opportunities in the near future that may result in the need to make further organizational changes. Among other things, structural changes may be made necessary by the continuing evolution of deregulation and customer choice. These events and conditions notwithstanding, Duke should avoid making any organization changes that diminish the current sense of accountability and ownership of the distribution system that exists with the current organization structure. (Conclusion 1)
2. Revise employee incentive compensation measures in order to increase emphasis on system reliability. (Conclusion 2)
 - Develop a more balanced approach to promoting revenue and earnings, controlling costs and providing the highest practical quality of service to customers.

- Develop employee incentive compensation measures that place greater emphasis on system reliability.
 - Reserve earnings per share and earnings before interest and taxes goals for only the highest levels of the organization.
3. Develop and implement a comprehensive manpower-planning program. (Conclusion 3)
- Supplement the current resource planning method with a more thorough approach that provides a longer term projection of manpower needs considering total work backlog, employee utilization and productivity, attrition, and technology improvements.
 - Use information from the current work management systems to develop manpower planning models that can be implemented at the first or second level of management. These models should be designed to allow each manager to forecast workload based on driving variables and/or historical data. Utilization data and seasonality predictions should be used to translate bulk manhours into staffing levels throughout the year. The manpower planning process should be integrated with Duke's annual budgeting cycle, but should also be available for use as necessary during the rest of the year for "What if?" analysis and for adjustments due to changes in workload.
4. Reevaluate the South Carolina electric distribution system capital and O&M budgets and avoid any future cost control efforts until system reliability indices improve. (Conclusion 5)
5. Determine the root causes of the recent decline in electric system reliability. (Conclusion 6)
- Develop a plan for reversing the upward trend in outage frequency and duration. It is doubtful that this can be accomplished without increased O&M and capital spending in some areas. Duke should identify and implement methods for improving reliability that can be achieved without adversely affecting its cost of service.

CHAPTER V

Electric Distribution System Design, Construction and Maintenance

This chapter evaluates the policies and practices employed by Duke Power (Duke or the Company) in the operation and maintenance of its electric distribution system. The assessment was based on a review of organizational relationships within and among the departments responsible for managing electric distribution functions and resources, the management processes and practices employed and the metrics used to evaluate the performance of the electric distribution organization and its assets. Although the audit focused primarily on the December 2002 ice storm, BWG also reviewed events leading up to the storm, as well as policies and practices that impacted the company's ability to respond to the outages that occurred.

A. BACKGROUND

Duke Power serves more than 2 million customers located in a service area that includes approximately 22,000 square miles in central and western North Carolina and South Carolina. About one quarter of the customers are in South Carolina. Duke's territory is composed of urban, suburban and rural areas. The major urban areas are located along the Interstate 85 highway corridor and include large cities such as Greenville and Spartanburg in South Carolina and Charlotte, Durham and Chapel Hill in North Carolina. Duke also serves a large number of smaller cities in both states, as well as many true rural areas. Many of Duke's commercial and industrial customers occupy land adjoining the major inter-city highways. The bulk of the customers are located in the cities and towns and in suburban residential tracts. The terrain in both states includes a mixture of flat, hilly and mountainous areas. Much of the territory is heavily populated with large trees.

Duke's electric distribution system is composed of approximately 64,000 miles of overhead primary and secondary distribution lines and about 25,000 miles of underground distribution lines. Twenty-five to thirty percent of the lines are located in South Carolina.

B. EVALUATIVE CRITERIA

BWG used the following criteria to evaluate the operation and maintenance of Duke's electric distribution system:

- Does Duke have comprehensive plans for the expansion and modernization of the electric distribution system?
- Are Duke's distribution system design standards and specifications reasonable and adequate?
- Have the design standards and specifications been properly adhered to in constructing the distribution system?
- Did any design and construction factors limit or impair quick restoration of service during the December 2002 ice storm?

- Does Duke have comprehensive and effective maintenance programs for its physical plant?
- Are maintenance procedures thorough and effective?
- Are Duke's preventive maintenance programs effective in controlling outages at reasonable cost?
- Are Duke's assets maintained in a manner that minimizes down time or outages and ensures that an appropriate life cycle for each asset is attained?
- Does Duke have a reasonable and effective pole inspection program?
- Did deteriorated poles contribute significantly to the outages during the December 2002 ice storm?
- Does Duke have a reasonable and effective cable replacement program?
- Did the cable replacement program have an adverse impact during the December 2002 ice storm?
- Does Duke have an effective vegetation management program?
- Are supervisory, engineering, and O&M practices and procedures logical and effective?
- Is Duke's automated trouble analysis capability effective in predicting trouble before it happens? Is this information used to develop effective preventive maintenance programs?
- Does Duke have a quality assurance program related to the inspection, testing, and mapping of new or repaired facilities?

C. WORK TASKS

In conducting this review, BWG consultants interviewed a large number of managers and engineers in various electric distribution organizations, prepared and submitted data requests, reviewed and analyzed Duke's responses to the data requests and made site visits to observe electric distribution equipment in the field. The issues that were addressed included all aspects of planning, designing, building, operating, and maintaining the physical facilities required for reliable service.

D. FINDINGS AND CONCLUSIONS

1. Duke Power's electric distribution design and construction standards are well written and complete.
 - One of the key indicators of the effectiveness of the design and construction practices of any utility lies within its written standards and specifications. BWG was provided with a set of the standards and specifications on a compact disk and had the opportunity to

review those documents.¹ BWG determined that the written standards and specifications are remarkable in that they are complete and well written.

- Duke’s standards and specifications are “living” documents that are periodically reviewed and revised as determined necessary. In addition, between revisions of the standards and specifications, a means of immediately revising the standards and documents is accomplished through the use of “Distribution Letters.” The practice of periodically publishing these distribution letters as a need arises is also remarkable and an indication that Duke is providing a good effort to keep its design and construction practices current with a changing industry.
 - Moreover, Duke’s electric distribution system appears to have been constructed in accordance with the Company’s standards and specifications. Although a thorough audit of construction and work practices was not conducted, a limited inspection revealed that Duke’s design and construction practices are in compliance with the Company’s standards and specifications.
2. Duke Power’s design and construction standards may have prevented the distribution system from being optimally prepared for the December 2002 ice storm. (Recommendation 1)
- Duke Power’s distribution system has been designed in accordance with the National Electrical Safety Code (NESC) for medium ice loading criteria.² According to the NESC, most of South Carolina is classified as a “Medium Loading” area, wherein the NESC recommends consideration of one quarter of an inch of ice in the utility’s design criteria. The coastal tip of South Carolina is a “Light Loading” area, where no ice is expected.
 - Use of the NESC ice loading criteria is a good practice and meets standard utility practice. However, Duke’s South Carolina system is unusual in that parts of its service territory have a history of major ice storms, which may not be adequately addressed by the NESC. As shown in **Exhibit V-1**, since 1996, Duke has experienced six ice storms that affected from 20,000 to 333,000 South Carolina customers:³

¹ Data Request 1-2

² Data Request 2-4

³ Data Request 1-15

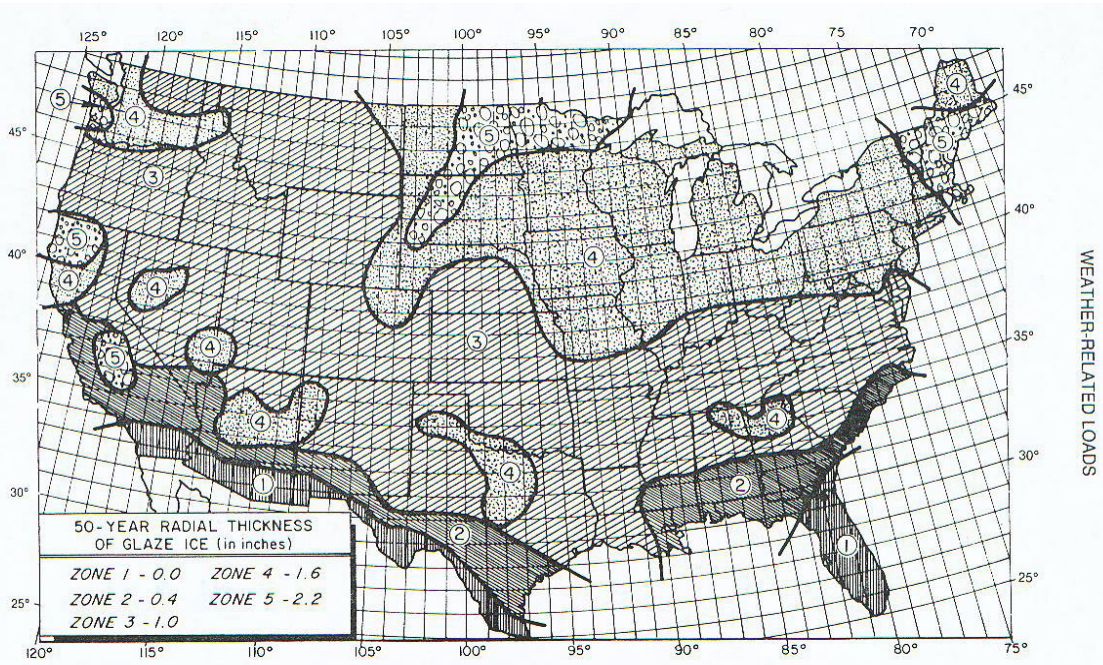
Exhibit V-1
Recent South Carolina Ice Storms

Date	Customers Affected	Duration
2/2/96	83,000	8 days
1/9/97	47,000	4 days
1/2/99	229,000	4 days
1/23/00	177,000	9 days
12/4/02	333,000	9 days
2/15/03	20,000	1 day

Source: Data Request JN 9-5 Q15

- In fact, a recent IEEE paper reported that the fifty-year maximum-recorded ice thickness in the northwest corner of South Carolina reached 1.6 inches.⁴ Also, American Society of Civil Engineers (ASCE) records show that most of Duke Power's South Carolina system falls within a Zone 3 (1 inch of ice) and some in Zone 4 (1.6 inches of ice), as shown in **Exhibit V-2**. This far exceeds the one-quarter inch of ice recommended by the NESC.

Exhibit V-2
ASCE Maximum 50-Year Ice Accumulation



Source: Malmedal & Sen – IEEE Paper “Structural Loading Calculations of Wood Transmission Structures”

⁴ Malmedal & Sen – IEEE Paper “Structural Loading Calculations of Wood Transmission Structures”

- Duke Power’s electric transmission system was designed and constructed based on a combination of NESC and ASCE standards.⁵ This likely has resulted in the design and construction of a stronger transmission system than one built using only the NESC recommendation. It should be noted that during the December 2002 ice storm Duke’s transmission system experienced minimal outages while the distribution system suffered extensive damage.
3. Duke Power is not adequately applying modern technology monitoring and controlling its distribution substations. (Recommendation 2)
- Duke does not have a Supervisory Control and Data Acquisition (SCADA) system for its distribution substations; nor does the Company appear to have any plans for future implementation of a SCADA system. This is quite unusual for an electric utility of Duke Power’s size and stature. Most large utilities, and many smaller utilities, across the United States have either installed or are in the process of developing and implementing SCADA systems.
 - SCADA systems provide many benefits. Among these are the following.
 - Notification of a substation or feeder problem is prompt and does not rely on customers to report such problems to the utility. This is especially important when telephone lines are out, as many were during the December 2002 ice storm, since customers without cell phones have no convenient means of notifying Duke Power of an outage.
 - Dispatch center personnel can be aware immediately of the kind and extent of any substation problem and can dispatch the proper personnel to take care of the problem based on information from the SCADA system.
 - Manpower costs are reduced, because the need to dispatch personnel to a substation to investigate and determine the cause and extent of the problem is reduced or eliminated.⁶
 - System reliability is improved when outage durations are reduced.
 - Substation security is enhanced through the use of alarms on gates and fences.
 - Safety is improved by eliminating the need for a person to be in the substation to carry-out switching orders.
 - Real-time monitoring of the system is available on a continuous basis.
 - Important system data can be automatically recorded and trended.
 - During storms, loading on feeder breakers can be monitored to determine how much load may have been lost due to down stream feeder problems.
 - Since Duke Power does not have SCADA in its distribution substations, distribution system operators and dispatchers must wait for customers to call-in outages before taking action. This method is relatively effective, but is also time consuming. Proper use of a

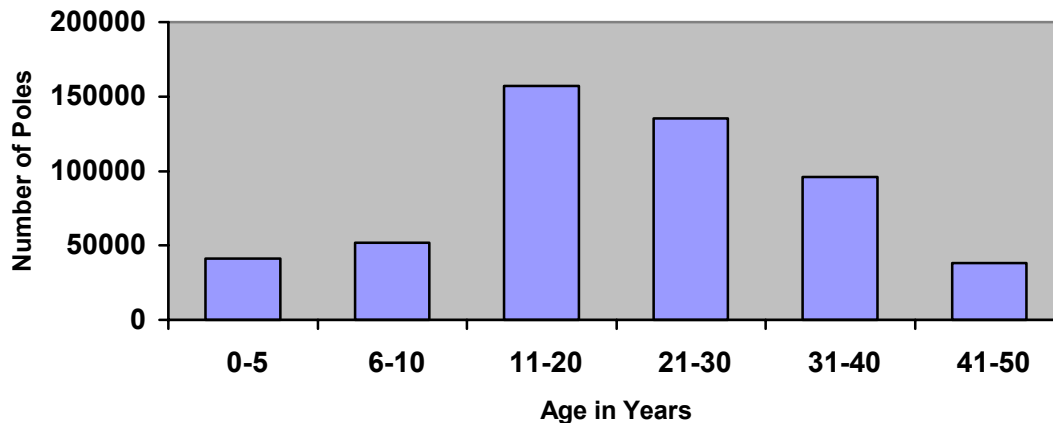
⁵ Data Request 2 - 4,5 &6

⁶ Dispatch Center Visit

SCADA system would provide valuable information for prompt analysis of system problems and would aid in the restoration of service during situations such as the December 2002 ice storm.

4. Duke Power's pole reinforcement program is a good practice.
- As mentioned previously, Duke Power currently has about 64,000 miles of overhead distribution lines. With rare exceptions, throughout Duke's system these overhead lines are suspended by standard wooden utility poles. Each year the average age of these poles increases. As depicted in **Exhibit V-3**, the graph below, the vast majority of Duke's poles are more than ten years old, and more than half are over twenty years old. As the average age of the poles increases, an effective pole inspection and maintenance program will become even more important.

Exhibit V-3
Age of Distribution System Poles



Source: Data Request 2-39

- Structurally sound overhead poles are critical to the integrity of any utility distribution system. The Duke Power system is no exception. Proper inspection and maintenance or replacement of overhead distribution poles is necessary in order to ensure public safety, employee safety and system reliability.
- Duke's pole reinforcement program enhances safety and reliability and also probably generates a cost savings. Distribution poles that are identified through Duke's pole inspection program as needing maintenance rather than replacement are reinforced with steel. The steel reinforcement provides added strength to marginal poles at the ground line, which extends the life of the pole and avoids more costly replacement.

- Duke replaced approximately 3200 distribution poles during the December 2002 ice storm. BWG determined that, in South Carolina, deteriorated pole failures did not significantly contribute to outages during the ice storm.⁷
5. Duke Power has not adhered to its ten-year pole inspection program. (Recommendation 3)
- There are approximately 519,000 poles on Duke’s distribution system in South Carolina.⁸ Duke Power stated that it maintains a twelve-year pole inspection program.⁹ This is contrary to the policy promulgated by the Company’s Distribution Standards, OM-40.01-1.0 General, which states, “The Line Inspection program is designed to inspect approximately 10% of the distribution system each year.”¹⁰ The Line Inspection Program was modified in 1998. One of the changes in the program was to revise the number of poles inspected annually from 1/10 to 1/12 of the population. Duke has stated that the Distribution Manual will be updated to reflect this change.
 - The Line Inspection program is administered at the system level. Therefore, the objective is to inspect 1/12 of the system poles annually, not 1/12 of the poles in each state. As shown in **Exhibit V-4**, it appears that even the 12-year goal was not met in South Carolina until 2002. Although the percentage has gradually increased, it did not reach the earlier design objective of ten percent in any year.

Exhibit V-4
Distribution Pole Inspection Program
For South Carolina
1998-2002

Year	Number of Poles Inspected	Approximate Percentage Inspected
1998	8,764	1.7%
1999	20,054	3.9%
2000	38,235	7.4%
2001	34,624	6.7%
2002	44,254	8.5%

Source: Data Request JS 9-5 Q42

⁷ September 30 interview with Lee Taylor

⁸ Data Request 2-39

⁹ August 6, 2003 Presentation by Jerry Ivey

¹⁰ Data Request 1-2

- BWG believes it is important for Duke to adhere to the design objectives of its distribution pole inspection program. **Exhibit V-5** is a photograph of a distribution pole that is adjacent to a main highway near a major shopping center in Spartanburg. According to the attached pole inspection tag, this pole was inspected by Duke in 1998 and, if Duke continues to adhere to its twelve-year cycle, will not be inspected again until 2010. Based on a combination of the stress on the pole and the potential for tree interference, both of which are evident in the photograph, BWG is concerned that this pole may not maintain its structural integrity until its next inspection. While BWG did not conduct an extensive inspection in the field of Duke's distribution poles, we are concerned that a large number of similar situations may exist.

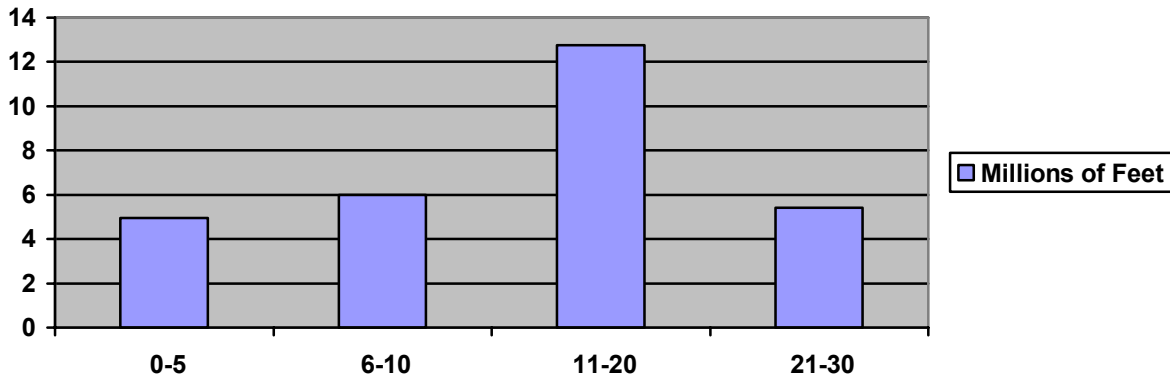
**Exhibit V-5
Stressed Distribution Pole**



Photograph by BWG, September 2003

6. Duke Power has an effective cable replacement program.
- Duke has approximately 25,000 miles of underground distribution cable.¹¹ About 17% of this cable is located in South Carolina.¹² As shown in **Exhibit V-6**, almost twenty percent of this underground cable is more than twenty years old.

Exhibit V-6
Age of Cable in Years



Source: Data Request 2-39

- The cable replacement program is important since cable outages are typically quite long and have adversely affected SAIDI in recent years.¹³

Duke has taken an aggressive approach and has replaced the amounts of cable shown in **Exhibit V-7** from 1998 through July 31, 2003 in the South Carolina portion of the Southern Region. (The South Carolina portion of the Central region was not available). The average for the complete years shown represents more than ten percent of the amount of cable over twenty years old. The typical age of the underground cable being replaced is approximately 30 years.¹⁴

¹¹ Data Request 2-13

¹² Data Request JS 9-5 Q42

¹³ September 30 interview with Lee Taylor

¹⁴ Data Request JN 10-02 Q10

Exhibit V-7
SC Cable Replacement (Southern Region)

Year	Southern Region Mileage
1998	17.67
1999	11.29
2000	5.85
2001	12.60
2002	14.31
2003*	7.16

* January 1 – July 31, 2003

Source: Data Request JN 8-22 Q42

- BWG determined that Duke Power used an outside source to perform analyses on cable samples. Tests are not performed on a routine basis because it has been proven that dc high-potential tests are harmful to aged polyethylene insulation. Low-frequency high-potential tests and most partial discharge tests elevate cable voltage well above its normal operating level. This too can be detrimental to cable reliability. There is also a lot of evidence within the industry that the results of these tests are often questionable. As a result, Duke has performed only limited testing in this manner. However, random tests are sometimes performed. What the Company has done is to submit field samples of aged cable to the National Electrical Energy Testing, Research, and Applications Center (NEETRAC) for microscopic evaluation. These studies demonstrate Duke Power's reasonable commitment to performing research on cable life.¹⁵
7. Duke Power has an extensive overhead distribution system that cannot economically be converted to underground.
- As previously discussed, approximately 75% of Duke Power's primary distribution system is overhead and 25% is underground. In future years, the underground percentage is likely to increase. Duke Power and other utilities are finding that most new commercial and residential subdivisions are requiring all new primary and new secondary services to be placed underground. In fact, as shown in **Exhibit V-8**, recent construction figures indicate that in South Carolina Duke Power's overhead system is becoming smaller while the underground system is expanding.¹⁶ Almost 500 miles of overhead lines have been removed from service, while approximately 900 miles of underground lines have been installed.

¹⁵ JN 10-02 Q11

¹⁶ Data Request – JN 9-5 Q1

Exhibit V-8
Changes in Duke Power's South Carolina System
1998-2003

Year	Overhead Miles	Underground Miles
1998	-674	38
1999	175	143
2000	8	212
2001	13	202
2002	5	189
2003*	-22	115

*Partial for year 2003

Source: Data Request JN 9-5 Q1

- Duke has experienced a number of severe ice storms in recent years. Each of those ice storms had an adverse impact on Duke Power's electric distribution system. Duke Power considers the December 2002 ice storm to be the worst one in the Company's history. As a result, many questions arose following the storm regarding the feasibility of Duke converting more of its overhead distribution lines to underground.
- The Company's internal studies indicate that the cost of converting overhead primary distribution to underground distribution ranges between \$500,000 per mile for simple lateral circuits to \$3 million per mile for more complex main feeders.¹⁷ These relatively high estimated costs are likely based on a number of factors.
 - Removal costs of overhead equipment
 - Loss of overhead capitalized investment
 - High underground design and construction costs
 - Land acquisition costs
 - Restoration costs
- It is difficult to develop an average cost for converting all of the overhead primary and secondary overhead lines to underground. However, assuming that the average conversion costs are \$500,000 per mile, the cost of conversion for the approximately 17,500 miles of overhead lines in South Carolina to underground would be \$8.75 billion. These numbers are based on the low-end costs for conversion of simple lateral circuits. The total cost for the conversion of the entire South Carolina distribution system to underground could easily be twice that amount or more. With about 500,000 customers in South Carolina, the average investment per customer would be approximately \$17,500 on the low end and possibly more than \$35,000 on the high end.

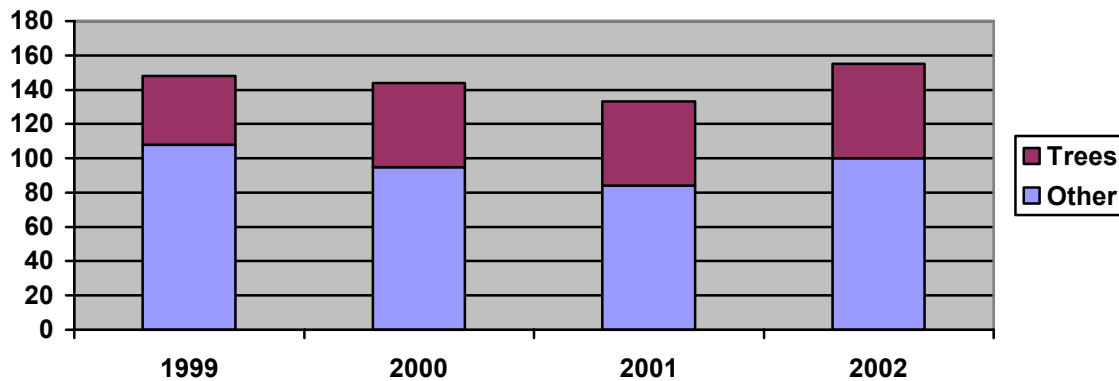
¹⁷ Data Request JN 9-5 Q G1

In addition, some other factors would need to be considered:

- The conversion would consume a tremendous volume of resources and would require many years, if not decades, for completion.
 - Maintenance costs would increase. Overhead lines, even with all of their limitations, are much easier and less costly to maintain than underground lines.
 - Although reliability would likely improve, certain other issues would emerge. Underground lines are normally not susceptible to outages caused by ice storms, thunderstorms, wind and tree contacts. However, underground cable testing and maintenance programs tend to be more costly than overhead programs. Replacement costs for underground cable also tend to be considerably higher than for overhead lines. Outages on underground systems tend to be longer and affect more customers. And, when a failure occurs on an underground line, the time and resources required to locate the fault and repair the problem are usually much greater than those required for an overhead line.
 - Nevertheless, new additions to the Duke Power system to accommodate new subdivisions, business parks and so forth should continue to be built using underground distribution lines wherever possible. This will ensure that the future growth of the system in terms of lines and equipment will be predominantly under ground. It will also enable the distribution system to better withstand weather related problems such as experienced during the December 2002 ice storm.
8. Duke's current vegetation management practice could contribute to future reliability problems. (Recommendation 4)
- South Carolina has an abundance of vegetation. The state is fortunate to have large forests with extremely tall and mature trees. Property owners and communities typically are proud of their trees and consider them a quite valuable and aesthetically pleasing asset. Unfortunately, trees and other vegetation often are in conflict with overhead power lines and can adversely impact the reliability of the electric distribution system.
 - In fact, BWG's investigation revealed that trees are one of the most common causes of outages on Duke's electric distribution system. As shown below in **Exhibit V-9**, tree-related outages accounted for about a third of outage durations (SAIDI) for the Company's South Carolina customers during the years 1999 through 2002. BWG also found that during the last 10 years the average duration of a tree related outage was approximately 183 minutes.¹⁸

¹⁸ Data Request 2-31

**Exhibit V-9
Tree-related SAIDI
(1999-2002)**



Source: Data Request 1-22

- Because of the high likelihood and long duration of tree-related outages, it is imperative that Duke have an effective vegetation management program that minimizes tree-related outages while respecting, as much as practical, the rights and wishes of its customers and property owners. However, BWG found several deficiencies in the Company's program.
- First, the length of Duke Power's tree trimming cycle is longer than many utilities in the industry and does not meet standard utility practices.
 - BWG determined that Duke currently employs a vegetation management program that could require more than seven years for a complete tree trimming cycle.
 - Duke has approximately 50,000 miles of overhead primary distribution lines with 14,000 miles or 27% in South Carolina. The Company plans for trimming of approximately 7,000 miles of these primary lines each year, which accounts for 13.5% of the system and would equate to a trimming cycle of approximately 7.4 years.¹⁹
 - The Company also reported that, on average, it has been employing a three to five year tree trimming cycle on urban circuits and five to eight year cycle on rural circuits.²⁰

¹⁹ Orientation Presentation, 8-4-03

²⁰ Data Request 2-22

- A number of studies have been performed that demonstrate that the optimal tree trimming cycle is four years, with some mid cycle trimming still being beneficial. An EPRI report released in the late 1990's stated that the ideal tree trimming cycle is 4.3 years. The Illinois Commerce Commission (ICC) has directed at least one utility to maintain a four-year tree trimming cycle,²¹ and the ICC Staff requires all other electric distribution companies to do the same. One utility in that state, Commonwealth Edison, maintains a four-year tree trimming cycle with a two-year, mid cycle trim.
- Second, BWG determined that Duke does not keep track of the types of problematic trees in its service area, does not track the annual growth of problematic trees,²² and does not have an idea of the numbers of trees along its lines and rights-of-way.²³ BWG believes knowledge of these facts is important to maintaining an effective tree trimming program. We are aware of a number of utilities that keep track of all of these statistics in order to more thoroughly estimate the amount of work that is required for vegetation management.
- Third, appropriations for South Carolina have not kept pace with those of the Duke Power system overall.
 - **Exhibit V-10** shows the annual expenditures for vegetation management for the years 1998 through 2002 in South Carolina and for the entire Duke Power system.²⁴

Exhibit V-10
Tree Trimming Costs (1999-2002)

Year	System Actual	System Budget	SC Actual	SC Budget
1999	\$20.3 million	\$20.5 million	\$6.8 million	\$7.1 million
2000	\$26.9 million	\$24.2 million	\$8.6 million	\$7.7 million
2001	\$37.5 million	\$35.4 million	\$9.0 million	\$7.3 million
2002	\$39.5 million	\$40.2 million	\$10.5 million*	\$12.0 million

* The December 2002 ice storm diverted tree trimming crews to storm restoration
Source: Data Request 2-24

- As depicted in **Exhibit V-11**, budgeted system wide tree trimming costs increased by 96% over the five-year period, and actual expenditures increased by 95%. During the same period, South Carolina's tree trimming budget increased by only 70% and the actual costs increased only by 54%.

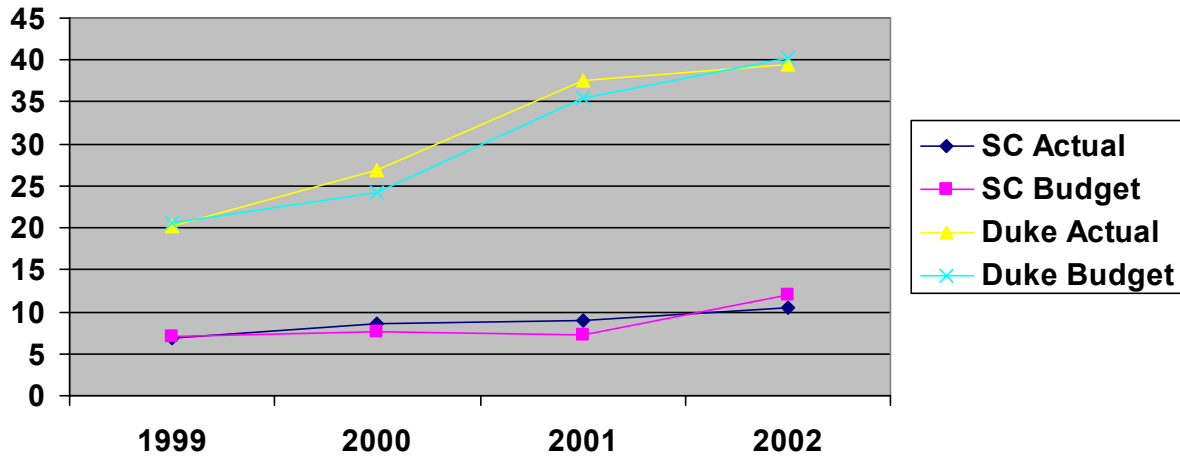
²¹ ICC Staff Report November 1, 2000 by Beth Bosch

²² Data Request 2-28

²³ Data Request 2-30

²⁴ Data Request 2-24

Exhibit V-11
Tree Trimming Budget and Cost Comparison



Source: Data Request 2-2

- Fourth, inspection of several distribution lines in the Spartanburg and Greenville areas revealed the following potential problems and conflicts with trees, which suggests that the distribution system is still quite vulnerable to tree related outages despite Duke's current vegetation management program.
 - Vegetation growing up poles and making contact with lines
 - Single phase laterals that are in the trees with dead leaves showing contact
 - Three-phase, covered conductor circuits in high growth areas with narrow clearing
 - Well-cleaned, three-phase main circuits with standard 30 ft right-of-way; however, many trees much higher than the power line so there is a high probability for off ROW tree problems
 - Tree growing into and above power lines, such as shown in **Exhibit V-12**

Exhibit V-12
Distribution Line in Spartanburg



Photograph by BWG, September 2003

9. During the technical investigation of this audit, BWG made a number of observations regarding the operation and maintenance of Duke's distribution system that indicated additional areas for improvement. (Recommendations 5 and 6)
 - The National Electrical Safety Code (NESC), Section 110.A – Enclosure of Equipment, states that metal fences “shall have a height of not less than 2.13 m (7 feet) and shall be grounded in accordance with Section 9.” As shown in **Exhibit V-13**, Duke's Pinewood Substation fence does not meet this standard. The chain link fence is considerably less than 6 ft tall and does not have a barbed wire section on top. In addition, there are a number of trees around the Pinewood Substation fence that could compromise the security of the substation by allowing access for someone to climb over the fence. According to Duke Power, the Pinewood substation was built prior to 1970 and the fence is grandfathered under the NESC that was in effect at that time. Nonetheless, fences below the recommended clearances present both a security and safety concern. An intruder gaining access to the substation could cause serious damage to the equipment or, if injured, could result in a serious liability problem.

Exhibit V-13
Pinewood Substation Fence



Photograph by BWG, September 2003

- The scope of BWG’s audit was limited to Duke’s distribution system. As a result, information concerning the transmission system, and particularly transmission system load shedding, was not provided to BWG. Therefore, conclusive statements regarding under frequency load shedding on the transmission system cannot be made. Nonetheless, BWG did conclude that a distribution load-shedding program would be beneficial to Duke Power.
 - Load shedding is important when a system starts to break up at the transmission level. When that happens, parts of the system will have a surplus of generation. This part of the system will go into an over frequency condition, but the generators can usually recover through governor action. On the other hand, other parts of the system may be generation deficient. In that case, unless load is shed to match generation, the system may collapse due to overloaded generators. If that happens, large generating stations, such as Duke’s coal and nuclear plants, may take many hours or several days to be restored to the system. One means of shedding load is through a distribution, under frequency load shedding program. Loads may be shed at the distribution feeder level.

- The lack of an under frequency load shedding program on the distribution system apparently had had no impact on the events surrounding the December 2002 ice storm. However, it could have if the transmission system had become fragmented as described above. Moreover, under frequency load shedding would definitely be beneficial in a situation similar to the Northeast blackout that occurred in August 2003.
- The Spartan Green substation has experienced outages due to large snakes crawling into energized parts. Duke Power has installed a snake fence at the Spartan Green Substation and installed animal protection devices on the incoming 24 kV over head distribution lines. Duke Power should be commended on these efforts.

E. RECOMMENDATIONS

1. Use a combination of the NESC heavy ice loading and ASCE standards as criteria for the design and construction of the electric distribution system. (Conclusion 2)
 - For economic reasons, this recommendation cannot be applied retroactively to the existing distribution system. However, for new construction, and where equipment is being replaced, the higher standard of utilizing both the NESC heavy ice loading and ASCE standards will increase the strength of the distribution system and make it more resilient to tree damage, ice storms and high winds.
2. Develop and install a SCADA system to include all major distribution substations. (Conclusion 3)
 - A SCADA system will greatly improve Duke Power's capabilities with regard to planning, operating and maintaining the electric distribution system. After developing and implementing a SCADA system, operators will be better able to quickly ascertain the status of the distribution system and analyze information such as loading levels and feeder circuit breaker open/close positions. Furthermore, the system dispatcher will be able to more effectively dispatch personnel to the field to expedite restoration of power to the customers during outages.
 - A priority list should be developed to install SCADA in the more critical substations first followed by less critical substations in descending order.
3. Increase the frequency of distribution pole inspections. (Conclusion 5)
 - As discussed in Conclusion 5, Duke's line inspection program was designed to inspect approximately ten percent of the distribution system each year. Duke stated that the Company recently changed the frequency of its pole inspection program to twelve years or approximately 8.3% of the poles each year. However, BWG found that in recent years the Company did not inspect 10% of its poles as required by its standards. In fact, our analysis revealed that pole inspections have not been conducted at the design rate of ten percent or even the recently imposed 8.3 % rate.

- BWG believes that, as a result of conducting so few pole inspections each year, there could be a large number of distribution poles in Duke's inventory that need maintenance, reinforcement or vegetation clearance.
 - While increasing the frequency of pole inspections will undoubtedly increase preventive maintenance costs, it is likely that these inspections will identify maintenance problems that, once corrected, will improve system reliability, prevent some future outages, and avoid reactive maintenance and restoration costs.
4. Reduce the cycle time of the tree trimming program to four years. (Conclusion 8)
- As discussed previously, trees are the leading cause of outages on Duke's electric distribution system and are second in average duration only to under ground cable failures. If major storm related statistics were included, the statistics for tree-related outages would be much worse. Duke personnel stated many times during interviews that over 90% of the outages of the December 2002 ice storm were caused by trees.
 - Although the initial cost of reducing the cycle to four years could be significant, it is likely that tree trimming costs eventually would be reduced from the current level. Tree trimming costs rise significantly in each year beyond year four, due to the fact that trunks, limbs and branches grow to a less manageable size and require more labor and heavier equipment to remove.
 - Moreover, reliability would probably improve. As would be expected, tree related outages are reduced to practically zero during the first year following a thorough trimming. Outage rates typically increase on circuits during each of the second, third and fourth years. After rising during the second, third and fourth years, outage rates tend to remain level during the fifth, sixth and seventh years. Thus, reducing the tree trimming cycle to four years would promote reliability at a higher level and reduce some outage repair costs.
5. Duke Power should conduct an internal audit of the security fences of all of its substations and bring the security fences for each substation into compliance with the NESC. (Conclusion 9)
6. Duke Power should develop a plan for implementing an under frequency load shedding program. (Conclusion 9)
- With limited understanding of the transmission system as a condition to this recommendation, it would appear that an under frequency load shedding program should be considered, designed and implemented on the Duke Power Distribution system. Under frequency load shedding programs have been used quite successfully for maintaining a high degree of reliability and are normally the responsibility of the utility's transmission reliability council.

- An under frequency load shedding program can also be used successfully in maintaining a higher degree of distribution reliability if the transmission system were to become fragmented due to a catastrophic event such as an ice storm or hurricane. In an area of the transmission system that is generation deficient, load shedding will match the load with the generation in order to avoid dropping large generating plants that, if dropped, could take hours or days to restore to normal service. To take the maximum advantage of the under frequency load shedding program, Duke should implement this in conjunction with a distribution SCADA system.

CHAPTER VI

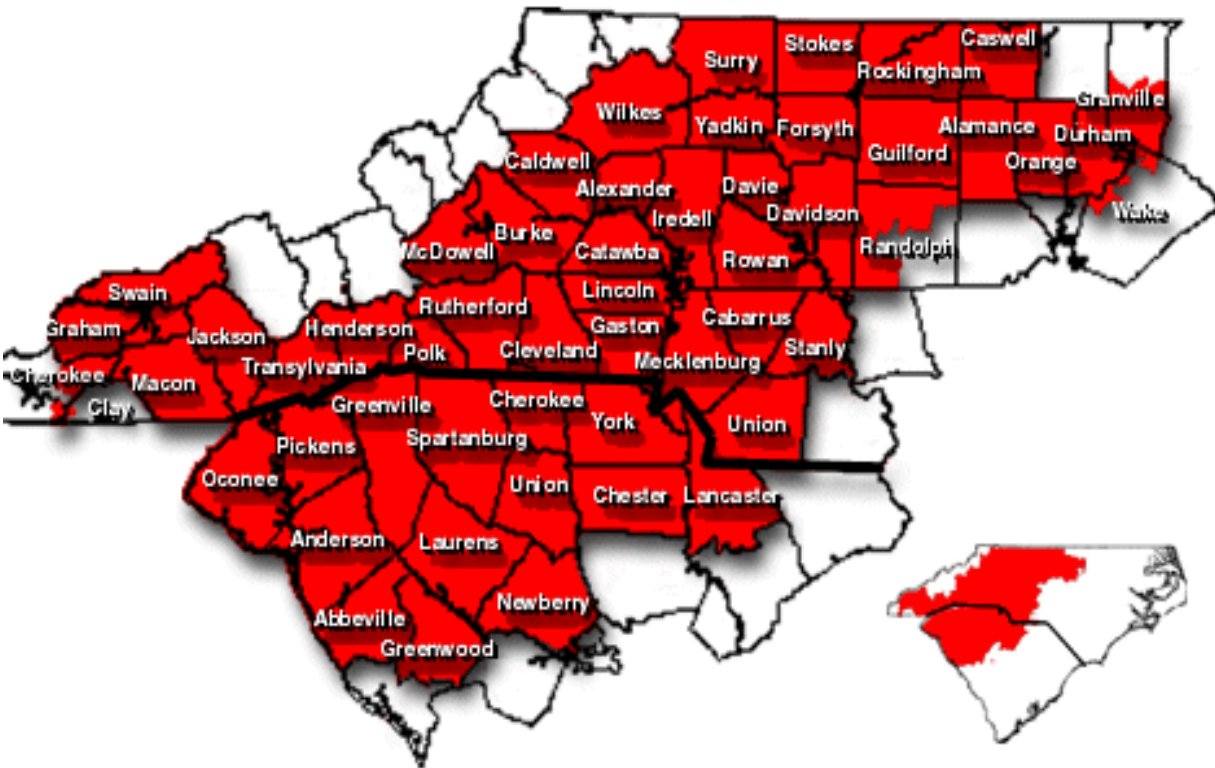
Customer Service

BWG’s audit focused primarily on the Duke Power Company’s (Duke or the Company) response to the December 2002 ice storm. The audit included a complete review of Duke’s handling of customer calls reporting outages, as well as its ability to provide timely and accurate information to its South Carolina customers related to estimated restoration times. BWG also analyzed Duke’s customer service organization structure, business processes, performance metrics, technology infrastructure and staffing levels in order to examine events and activities leading up to the ice storm and evaluate the Company’s overall effectiveness in providing reliable customer service to its customers.

A. BACKGROUND

Duke’s service territory covers 22,000 square miles in North and South Carolina stretching north to the Virginia border and south to Georgia. Duke serves approximately two million customers in the service area depicted in **Exhibit VI-1**.

Exhibit VI-1
Duke Power Company Service Area



Source: Data Request 2-52

Exhibit VI-2 shows the number of Duke’s customers by region and type as of 2002.

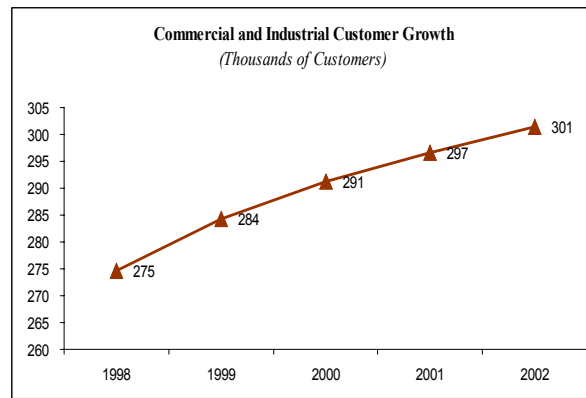
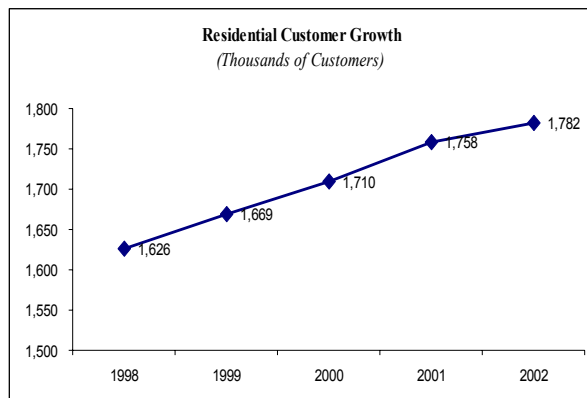
Exhibit VI-2
Duke Customers by Region and Type

	North Carolina					South Carolina			System
	<i>Northern</i>	<i>NorthWestern</i>	<i>Central</i>	<i>Southern</i>	<i>Total</i>	<i>Central</i>	<i>Southern</i>	<i>Total</i>	
Residential	421,253	459,389	401,357	82,834	1,364,833	53,531	364,019	417,550	1,782,383
Commercial and Industrial	64,044	81,333	61,525	15,997	222,899	11,158	67,403	78,561	301,460
Public Street Lighting	2,917	2,841	2,287	502	8,547	308	2,297	2,605	11,152
Totals	488,214	543,563	465,169	99,333	1,596,279	64,997	433,719	498,716	2,094,995

Source: Data Request 2-52

Duke serves one of the fastest growing regions in the United States and has subsequently experienced a growth of almost ten per cent in the last five years in the residential and commercial and industrial customer base, as shown in **Exhibit VI-3**.

Exhibit VI-3
Duke Power Customer Growth
(1998-2002)



Source: Data Request 2-52

B. EVALUATIVE CRITERIA

BWG conducted the evaluation of Duke's customer service functions using the following evaluation criteria:

- Were adequate plans established for dealing with emergencies?
- Were customer service levels adequate during the December 2002 ice storm?
- Are the customer service organization structure and responsibilities clearly defined?
- Is the customer service technology infrastructure adequate during normal situations as well as during the December 2002 ice storm?
- Is training adequate for customer service representatives?
- Are appropriate performance measures in place for the department?
- Are customer service performance metrics, levels and trends appropriate?
- Are customer service cost levels and trends appropriate?

C. WORK TASKS

In conducting this portion of the management audit, BWG consultants performed the following work steps:

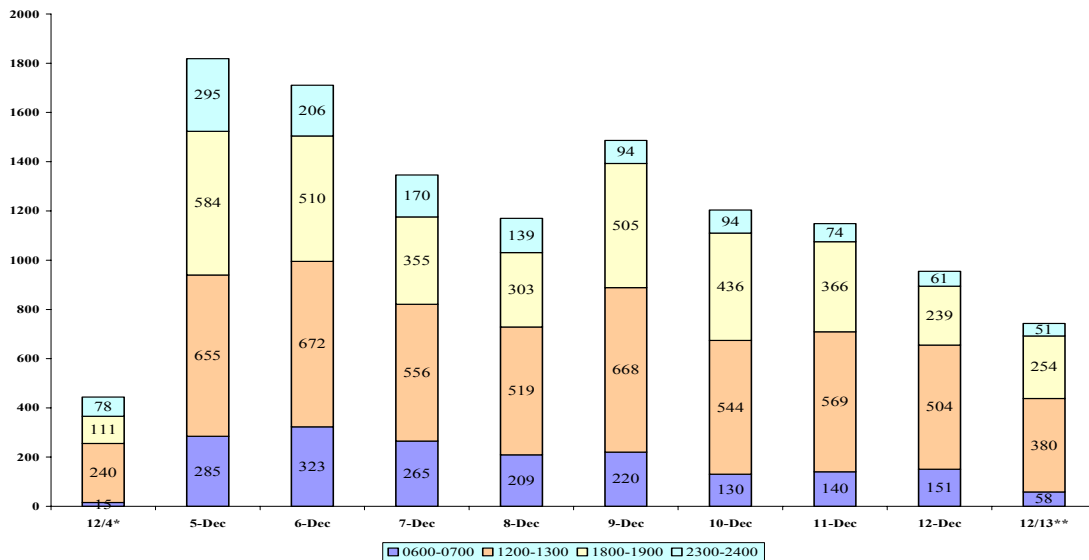
- Attended the initial management presentations conducted by Duke executives
- Interviewed management and line personnel from Duke's customer service organization
- Prepared and submitted data requests required for analysis
- Reviewed and analyzed Duke's responses to the data requests
- Toured the customer contact centers in Charlotte, NC and Greenville, SC

D. FINDINGS AND CONCLUSIONS

1. Duke's customer services department has a comprehensive plan for dealing with emergencies.
 - Duke's Customer Service Emergency Plan (the Plan) was developed to help coordinate efforts during emergency events. It sets forth operating guidelines, staffing needs, and high-level team responsibilities deemed necessary to respond to an emergency event. The Plan was revised on September 25th, 2002.
 - The Plan identifies four levels of storms, provides a definition of each level and describes the necessary steps to be taken in specific region/zone and customer contact center in preparation for every storm level.
 - The Plan provides role assignments, contact information for key participants and a pre-and post-storm checklist.

2. Duke’s customer service organization was not adequately prepared for the December 2002 ice storm. (Recommendation 1)
- Despite advance notice from Duke’s meteorologist that a significant weather event could bring intermittent light snow, sleet and rain to the Company’s service area by late morning on Wednesday, December 4th,¹ customer service did not significantly increase staffing levels in the call center until December 5th. **Exhibit VI-4** shows the number of employees in the customer call center during four selected hours each day beginning December 4th through December 13th. The chart does not include employees assigned to respond to business and industry lines and web inquiries.²

Exhibit VI-4
Ice Storm Staffing Levels



Source: Data Request 2-9

- When Duke did begin ramping up call center staffing levels, it had severely underestimated the need for additional resources. Duke planned its operation around “typical” or “expected” weather conditions in the models that it employed to forecast its staffing requirements during the emergency. The models used 250,000 outages as a “ceiling” with which to forecast staffing requirements to meet emergencies. Duke used two historical storm data files to evaluate staffing requirements for the December 2002 ice storm.³ These two storm data files, one a tornado that caused 152,000 outages and the other a thunderstorm that caused 55,000 outages, resulted in 156,280 and 19,001 calls respectively. These volumes of calls amounted to less than 10 per cent and 2 per cent

¹ Data Request 2-56

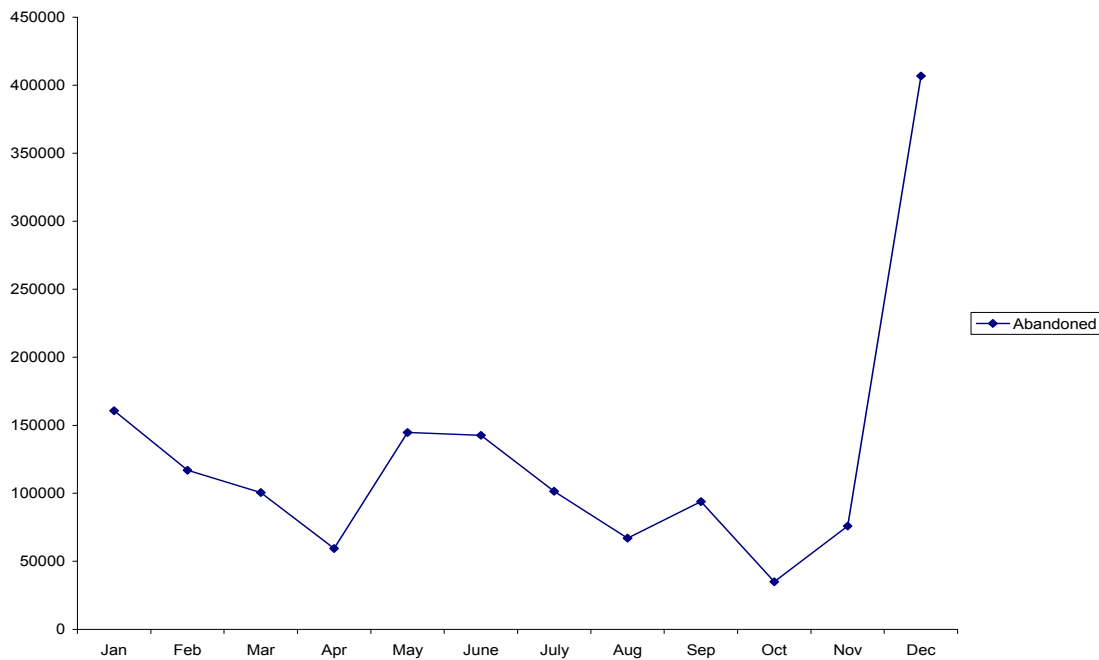
² Data Request AM 8-19 Q2

³ Data Request AM 9-5 Q3

respectively of the 1.6 million calls that Duke actually received during the December 2002 ice storm.

- Duke's failure to adequately staff the customer call centers at the outset of the storm contributed significantly to the extremely high number of abandoned calls in December 2002. **Exhibit VI-5** shows that more than 400,000 calls were abandoned in the month of December,⁴ principally due to the ice storm, indicating that the customer call centers were unable to effectively respond to the frequency and volume of incoming calls.

Exhibit VI-5
2002 Abandoned Call Volume Trend



Source: Data Request 2-1

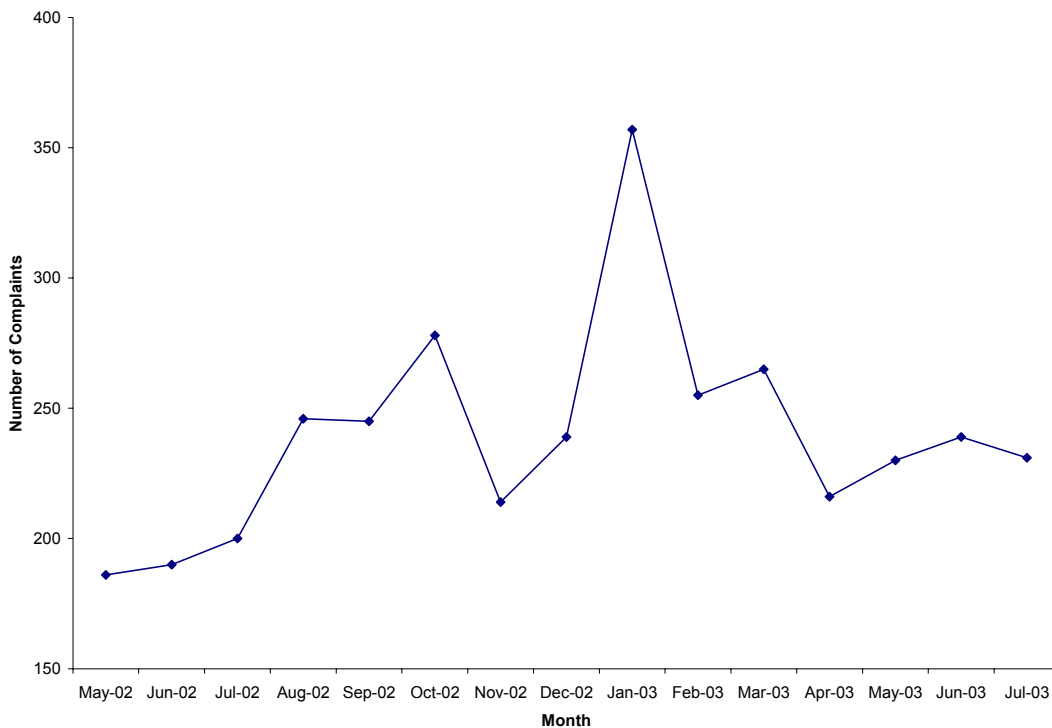
- Additional examples of Duke's inability to provide adequate customer service during the December 2002 ice storm were included in the Company's internal critique of its performance during the event⁵ as follows:
 - Inadequate communications capability with Spanish speaking customers in the service territory.
 - Inadequate clarification and explanation of roles and responsibilities of all Storm Process Owners, including the Storm Director.
 - Call guides not set optimally.
 - Lack of a structured process to plan for and optimize storm staffing.

⁴ Data Request 2-1

⁵ Data Request AM 9-3 Q11

- Lack of a seamless shift changeover process for storm directors.
- Lack of guidelines to determine and track which restoration teams should be released for breaks and when they should be released.
- Lack of a comprehensive employee skills inventory to identify who was best qualified to handle escalated calls for residential and business customers.
- Lack of a contingency plan surrounding staffing requirements if weather forecasts proved inaccurate.
- Inadequate equipment availability for customer service specialists at every workstation.
- Lack of a standard process to log in auxiliary agents including equipment set-up.
- All of these deficiencies apparently contributed to a much higher than normal number of customer complaints during the month following the storm, as indicated in **Exhibit VI-6**.

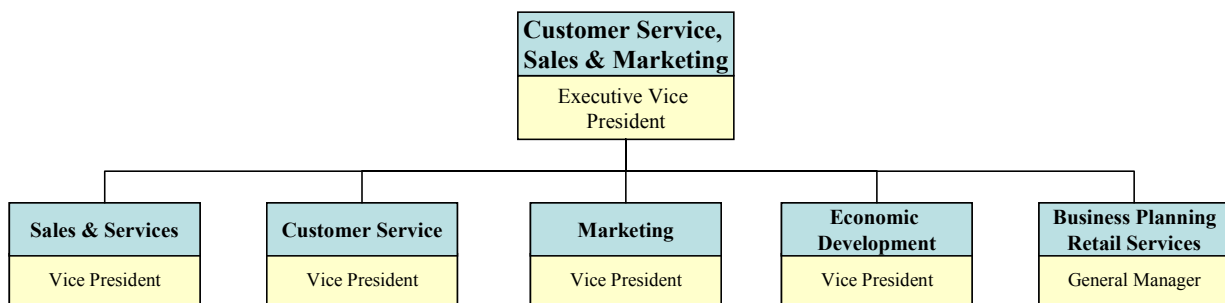
Exhibit VI-6
Customer Complaint Trend



Source: CSSM Monthly Management Reports May 02-July 03 (AM 09-03-01)

3. Duke's customer service organization is structured appropriately and roles and responsibilities are clearly defined.
- **Exhibit VI-7** illustrates the customer service organizational structure that was implemented in the spring of 2003. Some of the changes since the December 2002 ice storm include the following.
 - The creation of a separate economic development function with its own vice president. This function was previously managed by the Vice President of Sales and Services.
 - The customer service function has had its own vice president since the Customer Service Center opened.
 - The creation of a Vice President of Marketing position to oversee customer research and customer marketing programs.

Exhibit VI-7
Customer Service Organization



Source: Interview with Vice President of Sales and Service

- The primary objective of the Customer Service, Sales and Marketing (CSSM) organization is to provide timely and responsive service to its customers through effective management of people, processes and technology. Listed below is a brief description for each of the five functions that form the CSSM organization.
 - Sales and Services:⁶ This function includes approximately 167 personnel who interface with approximately 3,000 large commercial and industrial customers that require special attention in the form of dedicated account management support due to the size of load and revenues, and complexity of their operations.⁷

⁶ Interview with Randy Broome, Vice President of Sales and Service, September 4, 2003

⁷ CSSM FTE Headcount File obtained from Duke (AM 9-11-01)

- Customer Service:⁸ This function is comprised of the following three components.
 - 1) Customer Contact Centers: There are six customer phone centers that are linked together by an Interactive Voice Response (IVR) system and access the Duke Customer Billing & Information System (CBIS). The Customer Contact Center includes approximately 527 personnel and is managed by a General Manager.⁹
 - 2) Revenue Cycle Services: This includes all billing, credit and collections and accounting-related business processes. This group includes approximately 241 personnel and is managed by a general manager.¹⁰ The six managers who report to the general manager are each responsible for one particular aspect of revenue cycle services.
 - 3) Strategic Planning and Other: This group includes approximately 53 personnel and is responsible for providing all the support services to the customer service organization,¹¹ such as training of the specialists and coaches, facilities planning, budgeting and forecasting and special projects.
 - Marketing:¹² This function includes approximately 35 personnel who are responsible for market intelligence, product and service development, and implementation. The market intelligence group is comprised of five personnel who are responsible for customer satisfaction surveys.
 - Economic Development:¹³ This function includes approximately ten personnel who are responsible for attracting new businesses to the Duke territory. This area was recently organized as a separate function to improve focus on economic development due to the decline of the textile industry in the region. This function includes two directors, one for North Carolina and another for South Carolina, and a manager of planning and strategies.
 - Business Planning Retail Services:¹⁴ This function includes approximately eleven personnel who are responsible for compiling the Annual Operational Plan for the CSSM Department as well as working with the various divisions within CSSM to prepare the Annual Departmental Budget. The function is also responsible for compiling the CSSM Monthly Management Report that is used by the vice presidents and directors to track actual versus budgeted financial performance as well as operational performance.
- 4. While Duke's customer service technology infrastructure is generally appropriate, some of the new systems' capabilities are not fully understood, tested and utilized. (Recommendation 2)

⁸ Interview with Tony Almeida, Former Vice President of Customer Service, September 4, 2003

⁹ CSSM FTE Headcount File obtained from Duke, (AM 9-11-01)

¹⁰ CSSM FTE Headcount File obtained from Duke, (AM 9-11-01)

¹¹ CSSM FTE Headcount File obtained from Duke, (AM 9-11-01)

¹² Interview with Ted Schultz, Vice President of Marketing, September 4, 2003

¹³ Interview with Tony Almeida, Vice President of Economic Development, September 4, 2003

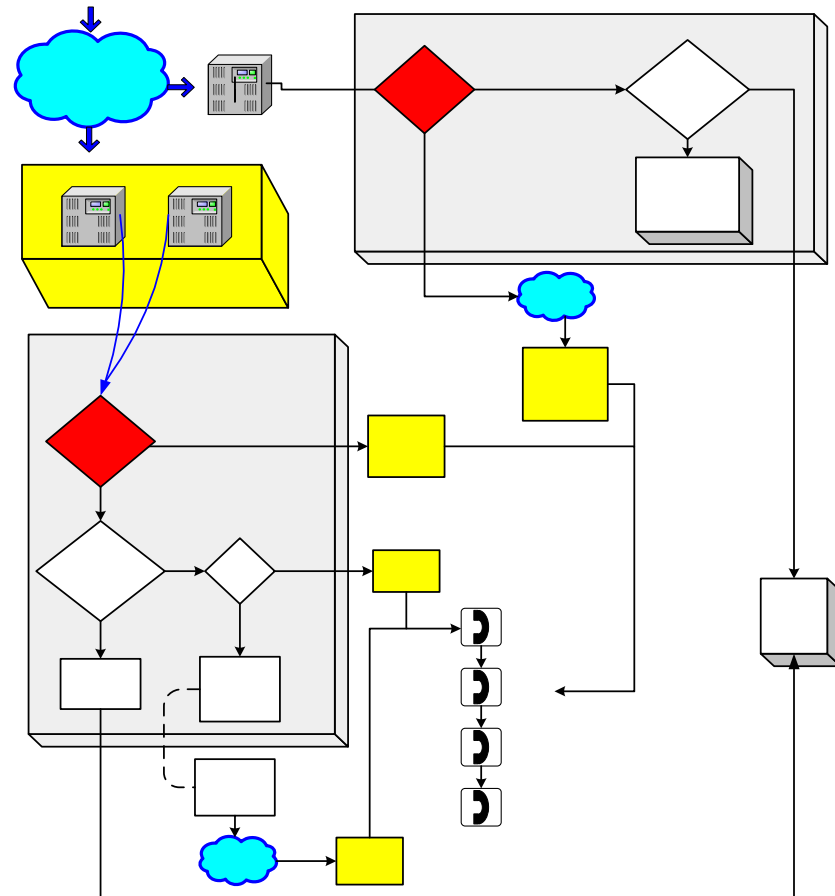
¹⁴ Interview with Benny Biddix, General Manager of Business Planning, CSSM, September 4, 2003

- Three systems are utilized by the call center specialists for reporting various customer requests with an interface to the CBIS.¹⁵ In most cases, there is an MQ Gateway that passes the requests from CBIS to the appropriate system behind the scenes:
 - Emergency Storm Reporting (ESR) is the outage management system that Duke has used for more than 20 years. The system reports outages and power quality issues and schedules some maintenance work.
 - OutageLink, the replacement tool for ESR, is an “off-the-shelf” software package solution that was implemented in October 2002. The interface is very similar to that of ESR in that it is presented on the desktop as a CBIS menu choice for reporting outages, non-outage requests, and power quality issues.
 - WorkLink initiates work requests for new services or upgrading existing services for customers. The call center has an interface to this system on the CBIS desktop. The Power Delivery department uses the system for managing new requests, assigning of work packages, and financial tracking of materials and resources.
- In addition to desktop interfaces, there are automated telephone-based customer interfaces. Duke began automating telephone-based customer interactions in 1993 using a technology commonly referred to as a voice response unit (VRU). One of the two automated applications that were developed is called “PowerOn.” This application enables customers to dial a toll free number to report power outages automatically using their service location telephone number. Customers who are unable to report an outage automatically are transferred to a specialist to assist them. PowerOn also provides an option to speak to a specialist to report fallen power lines or other emergency situations. These calls are routed to specialists at a high priority to facilitate answering these calls quickly.
- In 1994, Duke Power implemented an additional customer service focused VRU application known as “PowerTalk24” (PT24). Customers interact with PT24 when they dial any of Duke’s local customer service telephone numbers. In this application, customers are presented with four options. One of these options is “for outage and repairs.” As in PowerOn, these customers are then offered options to report outages or fallen power lines or other emergency situations as in PowerOn. This application also added the ability to report outages by account number and with the addition of outage reporting in PT24, increased the capacity for handling outage calls automatically. In 1996, Duke Power upgraded its telephone switch and VRUs to increase the capacities of the VRU and live voice call processing.

¹⁵ Data Request 2-5

- Duke also employs Twenty First Century Communications (TFCC) as an overflow provider to gain additional call processing capacity for outage reporting. In this upgrade, Duke established 332 lines to interact with PowerOn customers. If these lines become busy handling customer calls, additional calls automatically overflow to TFCC, which has a capacity of approximately 1,400 lines. Customers are then presented to TFCC's VRUs that have a copy of Duke Power's PowerOn application. As with Duke's version, customers are able to report their outages automatically or report fallen power lines or other emergency situations. If customers are unable to report their outage automatically, they are asked to call Duke Power's customer service number listed in the telephone book. If they are reporting a fallen power line or a similar emergency situation, they are routed to Duke Power specialists through a toll free number at a high priority to facilitate answering these calls quickly.
- In December 2002, a toll free number was established to allow Spanish speaking customers access to outage-related information and also provided another way for these customers to report their outages to a Spanish speaking specialist. By the end of 2003, Duke plans to implement an automated Spanish outage reporting system. In 2003, PowerOn and outage reporting in PowerTalk24 added the capability for customers to report their outage by social security number.
- **Exhibit VI-8** below is a diagram of the outage reporting call flow and provides an overview of the relationships between customers, VRUs, telephone switches and TFCC.

**Exhibit VI-8
Outage Reporting Call Flow**



Source: Data Request 2-5

- In 1995, Duke chose to build and implement its own customer and billing information system following a technical architecture that allowed the gradual replacement of the old Customer Information System (CIS).¹⁶ The old CIS continued to run while the new system took over more and more of the processing. The effort to build Duke's new system was dubbed the Phoenix Project, and its project team spent six years planning, designing and implementing the new system so that impacts to employees were minimal, and to customers, seamless.

¹⁶ Data Request 3-7

CSC 600 Switch

- Duke's new Customer and Billing Information System (CBIS) affects work processes and desktops of over 2,000 employees. The CBIS includes more than nine million lines of source code, and its database currently stores more than half a trillion characters of data.
 - While Duke continues to implement new technology to facilitate its customer service operations, the new systems' capabilities are not fully understood, tested and utilized.¹⁷ Comments included in the 2002 Ice Storm Critique Feedback Matrix and May 2003 High Winds Storm Critique indicated the following:
 - Incorrect data mapping caused problems with the VRU interface resulted in an inability to process outages through the automated systems and dumping too many calls to live voice.
 - Inadequate training resulted in user frustrations using the OutageLink system with performance not being acceptable.
 - No central view of operations to know systems status due to a lack of an operations dashboard.
 - Updates to upfront VRU were not timely due to lack of resources.
5. Duke has established an excellent training program for customer service specialists newly hired into the organization.
- New customer service employees receive five weeks of training.¹⁸ The first three weeks are a combination of instructor-led and web-based training. In addition to receiving training on how to use the systems, employees learn the following:
 - Basics of electricity
 - Achieving telephone excellence (what makes up a quality call)
 - Product promotion
 - How to process power outages
 - How to process requests to connect, disconnect or transfer service
 - How to process billing inquiries
 - How to process delinquent inquiries
 - How to process high bill inquiries
 - During training, customer service specialists have an opportunity to sit with other specialists and listen to phone calls. Once trainees learn a specific task (e.g., How to process power outages), they then log into a specific call pilot in the training room and answer calls from actual customers.

¹⁷ AM 9-5 Q9

¹⁸ Data Request 3-6

- During the last two weeks of training, customer service specialist trainees are in the "phone lab" in a pilot that receives all of the call types they were trained to answer. The trainees take actual customer calls and experienced specialists are available to assist with questions.
 - Additional training is provided to specialists on an as-required basis. The training varies from one to two days, based on their team assignment. Topics covered during this training include deferred payment arrangements (DPA), billing overview, bankruptcy, and high bill.
6. Duke did not provide adequate and consistent training to its auxiliary agents who handled escalated calls during the December 2002 ice storm. (Recommendation 3)
- Training for auxiliary agents was inconsistent due to the fact that it was not provided by the department's regular training staff. Further, as indicated by the highlighted section in **Exhibit VI-8**, only 165 hours of refresher training was provided to various employees prior to the December 2002 ice storm.

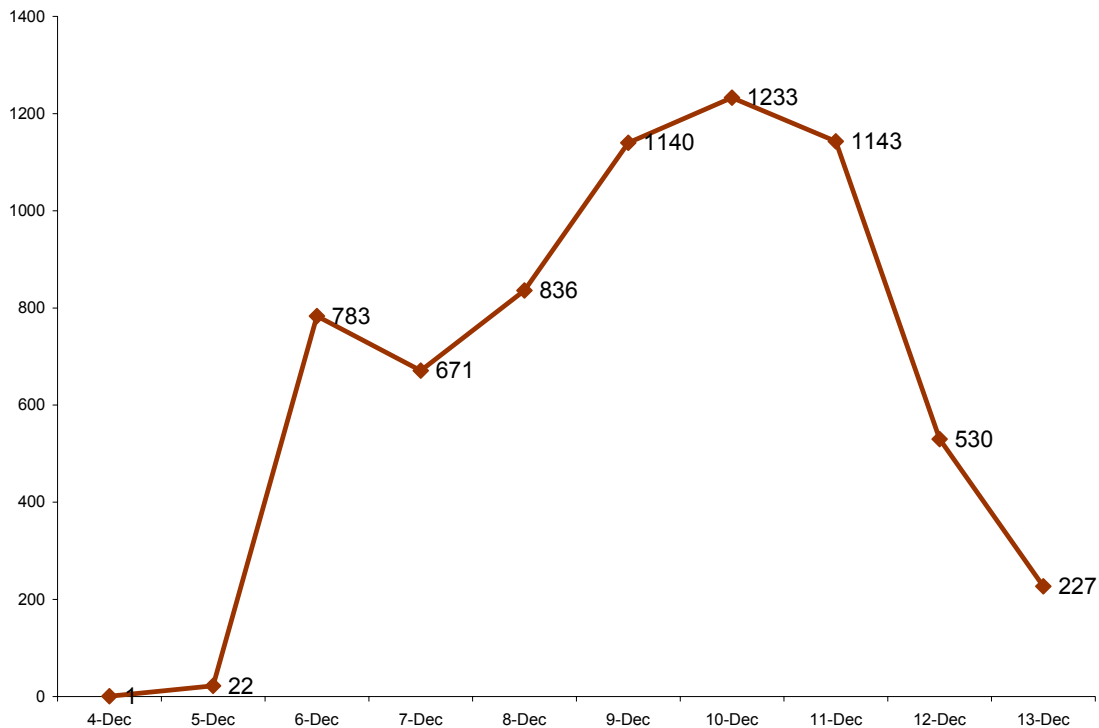
Exhibit VI-8 **2002 Training Hours**

Type of Training	Number Empl Trained in CCC (includes all spec, Team Leads, Coaches and QAT)	Number Empl Trained In Billing (SAS, CBIS Support, Billing Mgmt)	Number of Empl Trained in Debt Mgmt (RM, EP, Mgmt)	Number of Empl Trained in Training & PD&I	Number of Training Hours per Employee	Total Training Hours	Process
New Employee Base Call	80				120	9600	CCC
ResCon	25				24	600	CCC
B&I	24				80	1926	CCC
SAS Training		291			7	683	Billing
OutageLink*	502x6=3012	136x2=272	55x2=110	14x6=84		3478	ED
CCC Work Project	492	16		14	1	523	Billing
e-Bill	470	120	40	14	1	644	Billing
FPP	470	120	40	14	1	644	Billing
Billing Overview	480	16		14	3	1539	Billing
Refresher ESR Training (prior to December storm)		120	40	5	1	165	ED
Misc CINO Trng	44				4.5	198	Billing
Total Training Hours						20,000	

Source: Data Request AM 9-5-Q2

- The escalated call group needed basic training to operate the Duke Call center telephone system and to resolve customer complaints related to outage restoration efforts, ETOR's (Estimated Time of Restoration), and specific customer concerns. **Exhibit VI-9** depicts the volume of escalated storm calls per day during the December 2002 ice storm.¹⁹

Exhibit VI-9
Ice Storm Escalated Call Volume



Source: Data Request AM 2 Q10

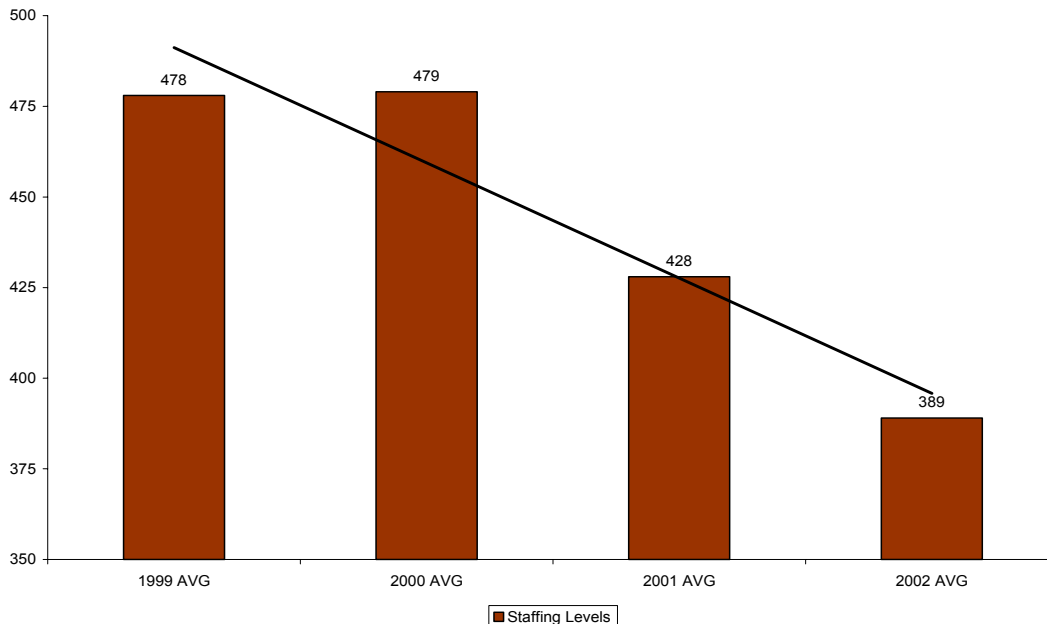
7. Duke's customer service performance measures are appropriate and typical of other utilities in the industry.
 - Duke tracks performance measures at a total system level, since it has only one centralized switch board and operates as one virtual call center.²⁰ Due to this structure, data is not available at a state or region level. The two key performance measures are:
 - Percent of calls answered within 30 seconds, and
 - Average time it takes to handle a call in seconds.

¹⁹ Data Request 2-10

²⁰ Data Request AM 2 Q1

- Other measures that are tracked include:
 - Calls Offered to Switch - This is the total work load of calls. It is derived by the following calculation: offered to specialist + handled by VRU + abandon in VRU.
 - Calls Offered to Specialist - This is the total work load of calls offered to specialists. It includes calls answered by specialists and calls abandoned in the queue.
 - Calls Answered by Specialist - This number is the calls actually answered by a specialist.
 - Calls Handled by VRU/PT24 - This is the number of calls answered by the VRU and the customer received information or transacted business (e.g., reporting an outage or setting up a DPA) and then hung up.
 - Calls Abandoned – This is the total number of customers that hang up either while on the VRU or the switch before the call is answered.
8. Duke may have reduced staffing to the detriment of service levels. (Recommendation 4)
- As indicated in **Exhibit VI-10**, Duke reduced customer call center staffing by approximately nineteen per cent between 1999 and 2002. The exhibit shows total full time equivalent employees (FTEs) employed at the end of each month between 1999 and 2002. One FTE equals one 40 hours per week employee or two 20 hours per week employees.

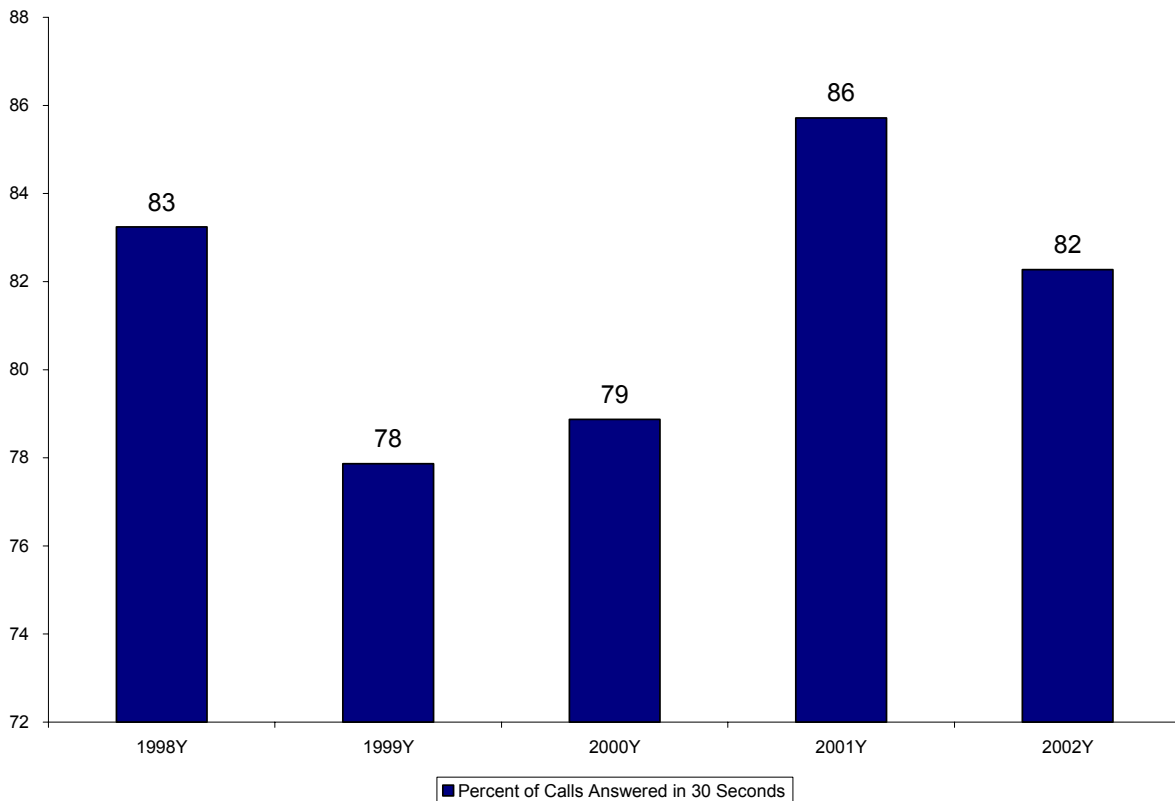
Exhibit VI-10
Customer Call Center Staffing Trends



Source: Data Request 2-2

- The staffing cuts occurred at a time during which the number of customers in Duke's service area increased by almost ten per cent,²¹ total call volume increased by approximately thirteen per cent²² and customer service levels declined. Duke's five-year average for percent of calls answered in less than 30 seconds is approximately 81 per cent²³, which is in line with the 2002 mean first quartile performance benchmark for the utility industry based on a study conducted by PA Consulting.²⁴ As shown in **Exhibit VI-11**, the Company's performance in this area fell slightly by approximately 9 per cent between 2001 and 2002 from 88 per cent to 79 per cent. During that time, Duke moved from the first quartile to the second quartile in the benchmarking study.

Exhibit VI-11
Percent of Calls Answered in Less Than 30 Seconds



Source: Data Request AM 2 Q1

²¹ Data Request AM 2 Q2

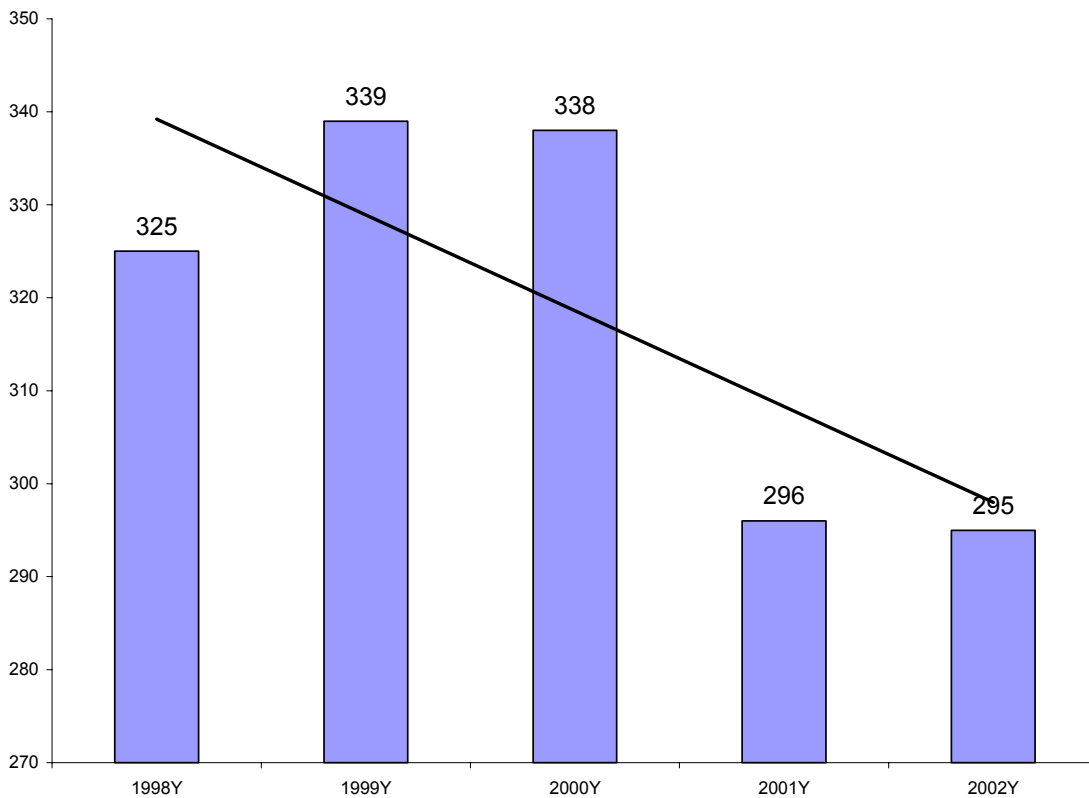
²² Data Request AM 10-3 Q1

²³ Data Request 2-1

²⁴ 2003 Customer Service Scorecard Report by PA Consulting – Page 1 (AM 08-26-01)

- As depicted in **Exhibit VI-12**, Duke’s five-year average for average handle time is approximately 318 seconds. In the last two years, Duke has averaged approximately 295 seconds for average handle time. This reduction in average handle time is evidence of Duke’s success in “controlling the call,” a term used in reference to the practice of attempting to keep call durations as short as reasonably possible.²⁵ Reducing average handle time is an acceptable means of decreasing workload and eliminating unnecessary staff. However, a more effective means would be to focus on eliminating unnecessary calls. Duke currently ranks among the highest utilities in the nation with regard to the number of calls received per customer.²⁶

Exhibit VI-12
Average Handle Time



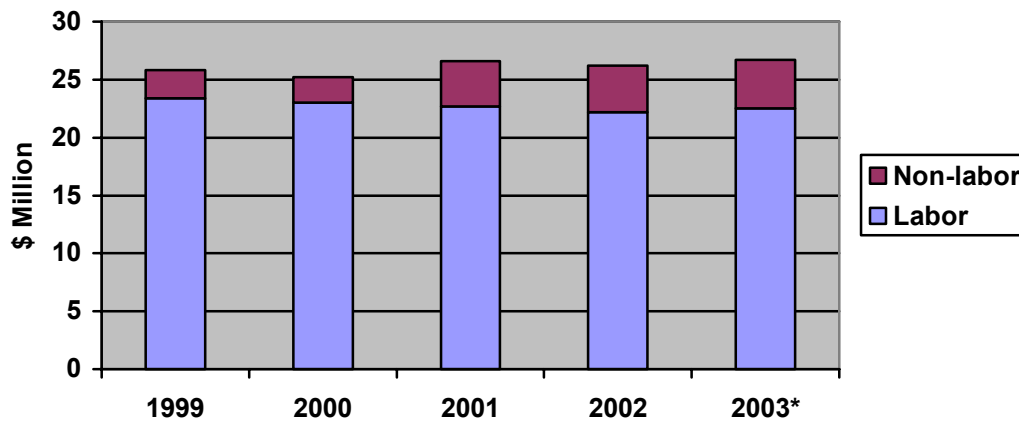
Source: Data Request AM2 Q1

²⁵ Interview with Rachel Moore, Call Center Specialist, September 5, 2003

²⁶ Chartwell Customer Care Report

- Despite the staffing cuts, the labor component of Duke’s O&M costs is quite high compared with other utilities with over 500,000 customers. As shown in **Exhibit VI-13**, in the last several years Duke has spent about \$25 to \$27 million on O&M annually to support its CSSM organization. The labor component has accounted for 85 to 91 percent of the total amount.²⁷ Analysis by Chartwell, a research group focused on the retail side of the energy industry, indicates that for utilities with over 500,000 customers, call center operating costs attributable to labor and benefits average around fifty percent.

Exhibit VI-13
Customer Service Operations Budget
(1999-2003)



* Budgeted O&M Costs
Source: Data Request AM 2 Q3

E. RECOMMENDATIONS

1. Modify emergency planning procedures in order to implement a more effective means of estimating resource requirements. (Conclusion 2)
 - Recognize that customer expectations have changed and will continue to escalate both during normal business and in emergencies.
 - Develop and implement a more thorough means of estimating the number of outages expected during an emergency, as well as the corresponding number of customer calls that will need to be answered.
 - Develop and implement a procedure for rapidly increasing customer call center staffing levels based on the estimates.
2. Conduct a comprehensive assessment of customer service business processes and technology infrastructure in order to identify opportunities to improve service levels while continuing to control costs. (Conclusion 4)

²⁷ Data Request AM 2 Q3

- Develop business processes and information technology infrastructure that are sufficient for responding to extraordinary events that may have an extremely low probability of occurrence but a significant potential for impact on resource needs and service levels.
 - Improve Duke’s capability to provide customer-specific information during emergencies.
 - Use the wide range of information available pertaining to all aspects of customer service to determine the root causes for all areas in which customer service has declined. Place responsibility for the analysis and the development of resulting action plans with the existing line managers.
3. Provide regular training to Duke’s non-customer service employees who may be required to serve as auxiliary agents during an emergency. (Conclusion 6)
- Ensure that the auxiliary agents are familiar with applicable customer service emergency procedures, as well as call center communications technology.
 - Provide training throughout the year, but especially prior to the seasons during which major storms (i.e., hurricanes, ice, freezing rain, etc.) are likely to occur.
4. Determine the optimum staffing required in the customer call center in order to achieve an appropriate level of service to Duke’s customers. (Conclusion 8)
- Review customer call center performance during the last several years and set targets for the desired levels of service.
 - Evaluate staffing requirements for specialists, supervisors and administrative personnel based on workload and quality control needs.
 - Revise work processes and procedures as necessary in order to control costs while accommodating the necessary staffing levels. Include an examination of Duke’s policy for staffing the customer call center on a twenty-four hours a day, seven days a week basis. While this can be viewed as beneficial from a customer perspective, it is important to note that only about 20 per cent of utilities surveyed by Chartwell indicated that they maintained a 24/7 operation.²⁸

²⁸ The Chartwell Customer Care Report, Page 33 and Page 34, (AM 08-26-01)